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RECREATIONAL BOAT HARBOR, CEDAR RIVER, MICHIGAN. REVISIONS TO G--ETC(U)
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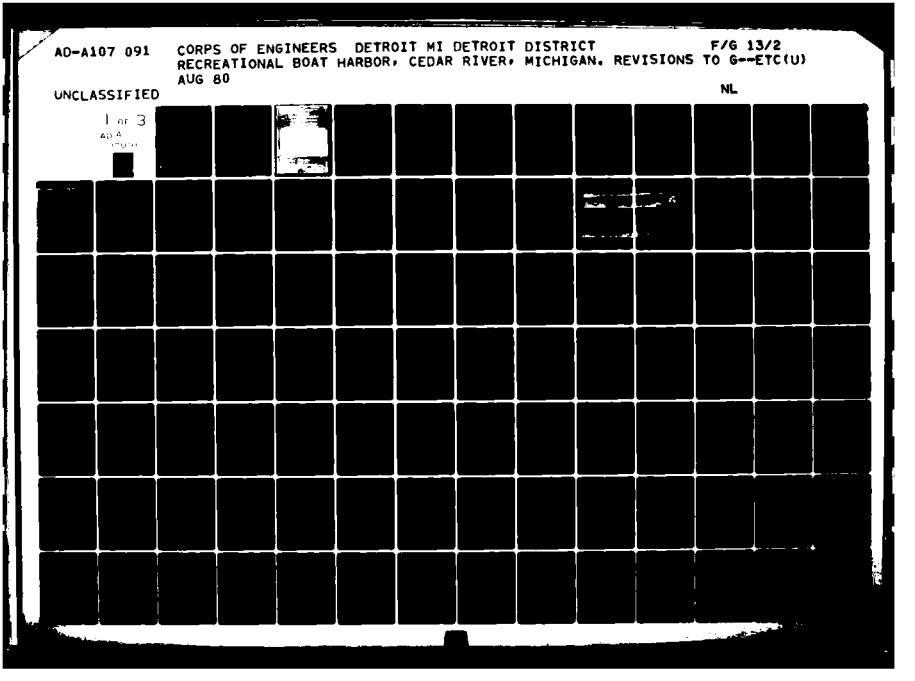

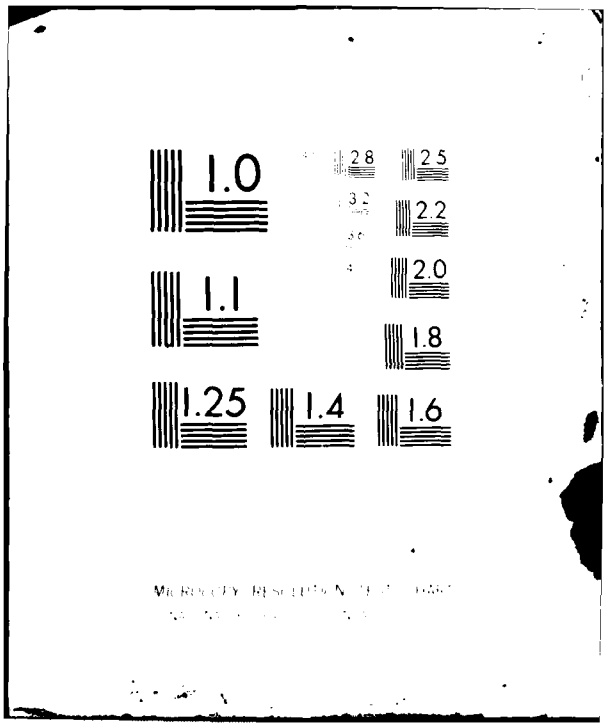
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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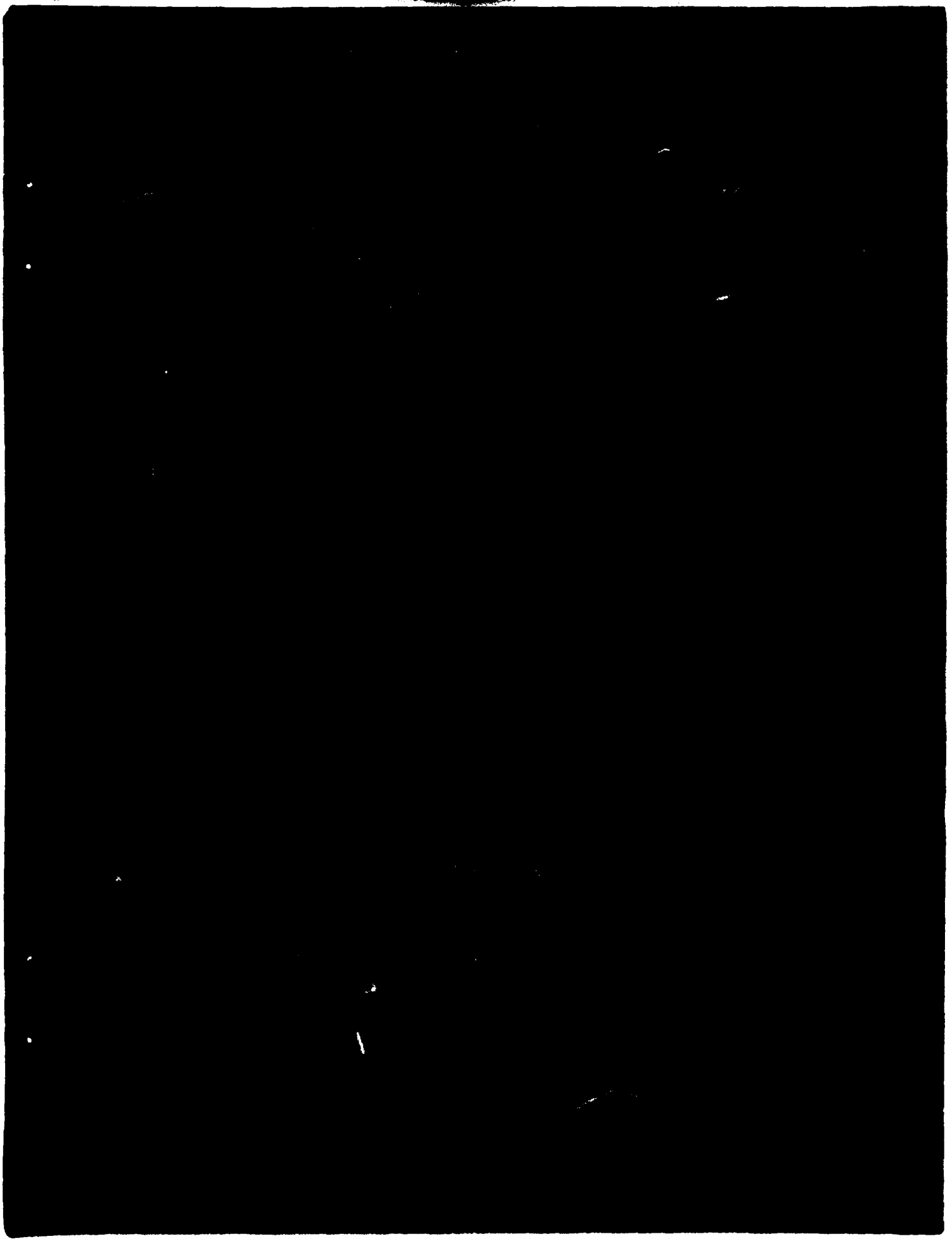

SYLLABUS

A small boat harbor located at the mouth of the Cedar River in the western upper peninsula of Michigan has long been the goal of the Michigan Department of Natural Resources and local entities. Because of the distances between the two existing adjacent harbors of Escanaba, Michigan and Menominee, Michigan, a local harbor of refuge (small boat harbor) would be convenient to area boaters.

The harbor is located at the mouth of the Cedar River on the western shore of Green Bay about 68 miles north of Green Bay, Wisconsin and situated within the J.W. Wells State Park. As early as 1882 attempts were made to improve the river mouth for navigation. Early improvements consisted of construction of stone filled wooden piers to aid entrance into the Cedar River anchorage area. Minor repairs have been made since that time but no substantive work has been completed to the original works. Plans for improvement of the area to assist local boaters have lain dormant since the original Congressional authorizations. In August 1968 a General Design Memorandum was published which contained a plan of improvement for the Cedar River area. This plan, however, also was not implemented.

The present plan of improvement requires construction of an eastern pier, 875 feet in length of rubblemound construction, and rehabilitating the existing western pier with rubblemound construction (navigation lights would be installed on each pier). The construction would allow a recreational small boat harbor to be built by the Michigan Department of Natural Resources upstream of the described construction.

Cost of the improvements at Cedar River is estimated to be $1,306,300 as of January 1980. The average annual cost amortized over a 50 year operational period at 3 1/4 percent interest equals $68,010 while benefits attributed to the construction sum to $212,650. Benefit-cost ratio for the improvements is 3.13.

If the plan of improvement is authorized for construction, the contract advertising date could be set for January 1982 and the construction period then defined from April 1982 until July 1983.

Supplement No. 1

REVISIONS TO

GENERAL DESIGN MEMORANDUM NO. 1

CEDAR RIVER HARBOR
MICHIGAN

U.S. ARMY
CORPS OF ENGINEERS
DETROIT DISTRICT
DETROIT, MICHIGAN

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SUPPLEMENT NO. 1

REVISIONS TO

GENERAL DESIGN MEMORANDUM NO. 1

CEDAR RIVER HARBOR, MICHIGAN

PERTINENT DATA

1. This Supplement to the General Design Memorandum pertains to dredging the Cedar River entrance channel to a depth of 10 feet from Lake Michigan to the River mouth and to a depth of 8 feet in the River up to the State Route 35 Bridge, both plus one foot overdepth,[1] construction of pier having a total length of 875 feet, and rehabilitation of an existing 230 foot pier. A summary of physical features and first costs follows:

PHYSICAL FEATURES	WIDTH, FT.	DEPTH, FT.	LENGTH, FT.
Channel dimensions Lake to River mouth	100	10	1,050
River mouth to upstream limit of dredging	80	8	1,000
Piers	-	-	875
East Pier rubblemound and pierhead and light base			
West Pier rubblemound and pierhead and light base-rehabilitation	-	-	230
Dredging			
Hydraulic dredge 2,050 feet of channel	40,000 cu. yds.		

[1] All depths in this Design Memorandum are referred to Low Water Datum for Lake Michigan, which is 576.8 feet above Mean Water Level at Father Point, Quebec, 1955 I.G.L.D. (International Great Lakes Datum).

First Cost

Federal First Cost	$1,074,070
Non-Federal First Cost	232,230
Total First Cost	$1,306,300
Benefit-Cost Ratio	3.13

2. PURPOSE AND EXTENT OF STUDY

Improvements at Cedar River have lain dormant since the original Congressional authorizations were proposed in 1882. Construction work was initiated in that year and continued until 1886 resulting in the dredging of an entrance channel 14 feet deep, and erection of two parallel piers extending into the lake from the mouth of the Cedar River. Since that time, no work has been done. Total costs to the United States through September 1979 were about $49,811. There have been no expenditures for maintenance. In 1926, House Document No. 467, 69th Congress 1st. session, recommended abandonment of the project, but no action was taken by Congress. A review survey report - the Coasts of the Great Lakes-Harbors of Refuge for Light-Draft Vessels - was prepared and published as House Document No. 446, 78th Congress, 2d session. Cedar River Harbor was one of the harbors considered therein for improvement as a harbor of refuge for light-draft vessels.* The report concluded that there was no need at that time for additional harbors of refuge in the northern part of Green Bay. Therefore, no improvement of Cedar River Harbor was recommended.

Since publication of General Design Memorandum No. 1 in August 1968, implementation of the project into the construction phase has been delayed primarily because of lack of interest from the local sponsoring agency. Not until 1979, with a revival of interest to obtain a recreational boat harbor in the area by the local sponsor, did the project become reactivated.

The present plan of improvement as contained in Supplement No. 1 of the General Design Memorandum, proposes to:

*The authorizing document of July 1965 did not consider establishment of this harbor at any other location in the vicinity. Similarly, the General Design Memorandum of August 1968, and this Supplement do not discuss alternatives to the Cedar River site, but employ the criteria set forth in the authorizing document--to improve the Cedar River facilities.

a. Shorten the length of the proposed east pier from 2,100 feet to 875 feet.

b. Replace the cellular steel pile pierhead with a rubble mound pierhead.

c. Rehabilitate 230 feet of the existing west pier and construct a new rubble mound pierhead around the existing navigational light.

3. CURRENT STATUS OF LOCAL COOPERATION

The status of local cooperation was reaffirmed by letter dated 17 July 1979 from the Michigan Department of Natural Resources and presents the favorable position of the State with regard to implementation of the Cedar River facility. Permanent easements must be defined by precise survey, however, because of certain legal requirements which established the J.W. Wells State Park.

4. More recently, in an effort to gather local information and input, a meeting was held at the Cedar River project site with staff members of the Michigan Department of Natural Resources, U.S. Fish and Wildlife Service, Corps of Engineers, local fishermen and businessmen and the Consulting Engineer. The participants at the February 21, 1979, meeting showed unanimous support for the proposed project.

5. The Michigan Waterways Commission at its May 31, 1979 meeting provided the required local support for the project. A copy of the resolution affirming this support is included in Appendix E.

6. On July 18, 1979, a similar meeting was held in Lansing to review the status and details of the project. Representatives of the Michigan Department of Natural Resources, U.S. Fish and Wildlife Service, Corps of Engineers and the Consulting Engineer were in attendance.

7. SUPPLEMENTAL INVESTIGATIONS

Investigations made in addition to those listed in General Design Memorandum No. 1, are listed as follows:

a. A soundings survey of the river and entrance channel area to determine estimates of dredging quantities (made in May and June, 1979).

b. A revised wave analysis of the Cedar River Harbor. The analysis included calculation of deep water wave parameters, wave refraction and defraction, wave runup on the proposed structure, wave overtopping and an assessment of the proposed structure impact on erosion patterns.

c. Revised cost estimates and financial analyses using current price levels.

LOCATION OF PROJECT AND TRIBUTARY AREA

8. LOCATION OF PROJECT

Cedar River Harbor is located at the mouth of Cedar River on the west shore of Green Bay about 68 miles north of Green Bay, Wisconsin. Originating in the northern part of Menominee County, Michigan, at a point about 35 miles from its mouth, the Cedar River drains an area of about 350 square miles, but the normal discharge of the river is small. In the reach from the mouth of the river to the State Route 35 bridge (approximately 1,700 feet upstream) depths range from 4 to 16 feet. The entrance channel has shoaled to a least depth of about 2 feet. Surrounding Cedar River Harbor is the J. W. Wells State Park, maintained by the Michigan State Department of Natural Resources.

9. TRIBUTARY AREA

The 1975 population of Cedarville Township was estimated at 271 and that of the county estimated at 25,376. It is projected that the permanent population of the township will double by the year 2000. The Village of Cedar River is primarily a settlement for fishermen with the adjacent cut-over hinterland sparsely settled. Forest products, principally hardwood lumber and pulpwood, are the commodities of exchange. Although

Aerial photograph of Cedar River project site. Built in 1862 of wooded piling w
to the shore, the east pier--remnants of which are visible above--has deteriorat

1862 of wooded piling with stone fill and originally connected
above--has deteriorated because of a lack of maintenance.

some cleared tracts are used for dairy farming, the tributary area is generally unsuited for agricultural development. Vacation attractions in the area include state forests, state and county parks, and the spring smelt run and sport fishing in nearby streams and in Green Bay. The J. W. Wells State Park, located along Green Bay on each bank of Cedar River, has an area of 974 acres with a sandy beach and facilities for picnicking and camping. State Route 35, passing through the Village of Cedar River, is a paved highway affording access to Escanaba and Menominee, Michigan. The nearest commercial and business center is at Stephenson, Michigan, a village about 12 miles due west. Stephenson had a population of 800 in 1970. Waterbourne commerce at Cedar River Harbor consists of locally harvested fish. There are usually eight commercial fishing vessels based in the Harbor. Recreational boating is not engaged in seriously because of unfavorable navigation conditions and a lack of permanent facilities.

The boat benefits were calculated in relation to the actual number of permanent and transient boats docking at Escanaba and Menominee Harbors during 1978. It is assumed that these figures would serve as an appropriate basis for determining number of boats expected to occupy Cedar River boat slips as they are the closest harbors to Cedar River. It is also assumed that population and income figures would be subject to increase following the construction of the harbor facilities in order to support the increased tourist activities, rather than those increases preceding harbor construction.

10. DEPARTURE FROM PROJECT DOCUMENT PLAN

The proposed project plan results from three revisions to the project plan of General Design Memorandum No. 1. These revisions reduced the length of the east pier, changed the construction proposal of the pierhead for the east pier, and proposed a new pierhead for the westerly pier along with rehabilitation of the pier itself.

a. Reduced Length East Pier

The decision to shorten the east pier would result in a reduction of shoaling within the entrance channel without significantly impairing the protective nature of the pier structure. The length of the pier presented in the General Design Memorandum No. 1 was 2,100 feet while the length of the new pier would be 875 feet, a reduction of 1,225 feet. A model study of the proposed reduced pier length was not conducted to verify the design wave conditions within the proposed anchorage area. Wave heights within the area of berthing would not differ significantly from those proposed in the authorized plan.

The project document plan as authorized provides for a cellular steel pile pierhead. A cost comparison between a rubblemound pierhead and a cellular steel pierhead indicates that the first cost of a rubblemound pierhead is $131,000 whereas a cellular steel structure would cost $144,400; hence the decision to use a rubblemound type pierhead. Environmental considerations also influenced the decision to use a rubblemound type structure, inasmuch as a rubblemound is preferable environmentally to steel sheet pile.

c. Rehabilitation of West Pier

The revised project plans for the rehabilitation of the 230 foot long west pier including a new rubblemound pierhead. The existing structure has suffered significant deterioration since this project was originally considered. Rehabilitation basically involves the replacement of riprap and cover stone. A detailed discussion of the rehabilitation effort is included in Appendix C of this report.

OTHER PLANS INVESTIGATED

11. GENERAL

Four alternatives including three pier designs were investigated in the preparation of this Supplement of the General Design Memorandum (see Table 1--System of Accounts). The designs were concerned

with the length of pier, (length influences the extent of shoaling and protective qualities).

12. Alternative No. 1 proposed the construction of a 2,100 foot long rubblemound pier on the east side (the project plan described in the General Design Memorandum No. 1). The cost of this project based upon August, 1979 price levels is estimated at $1,935.000.

13. Alternative No. 2 proposed the construction of a shorter pier than that proposed in Alternative No. 1, and forms the basis of the recommended plan. This plan provides for an east pier length of 875 feet. The cost of this project based upon the August, 1979 price levels is estimated at $1,306,300.

14. Alternative No. 3 reduces pier length further while Alternative No. 4 is the No Action Plan.

Table 1 addresses the comparative environmental effects of the various breakwater lengths (Alternatives 1, 2, and 3) and differ basically only on the degree of impact. The environmental quality plan (EQ) is that plan which enhances the environment over existing conditions. In the selection of the EQ plan the following factors were considered: 1) lake bottomland utilized; 2) aquatic habitat created; 3) beach nourishment; 4) materials and energy utilized; and 5) erosion and shoaling. The no action plan (Alternative 4) would allow the continued deterioration of the existing breakwaters, continued shoaling and erosion of the inner harbor mouth and would not create additional aquatic habitat and in particular an off-shore fish reef. Alternative 2 was selected as the EQ plan because it most enhanced the existing environment. This alternative could utilize the rubble of the existing east breakwater to create an offshore fishing reef.*

The National Economic Development (NED) Plan addresses the maximizing of net economic benefits. Using the economic portion of the material presented in Table 1, all alternatives are analyzed relative to their respective contributions of providing increased gains to national economic efficiency. Of the four alternatives presented in Table 1, Alternative 2 presents the most favorable contribution to the development of the NED goals.

Application of the EQ and NED criteria then yields the selection of Alternative 2 as the most acceptable plan to fulfill the requirements of the combined objectives.

*see Appendix G for details of fishing reef construction.

Cedar River
SYSTEM OF ACCOUNTS
Summary Comparison of Proposed Plans

TABLE 1 System of Accounts	PLAN 1 2100 Foot Pier	Plan 2 875 Foot Pier	PLAN 3 Short Pier	Plan 4 No Development
ACCOUNTS				
1. National Economic Development				
a. Recreational craft				
LOCAL:				
Before construction	$ 26,070	$ 26,070	Not evaluated	No change
After construction	45,720	45,720		
Prospective Transient	28,460	28,460		
Harbor of Refuge	5,550	5,550		
Sport Fishing	71,000	37,190		
Commercial Fishing	69,660	69,660		
TOTAL	$246,460	$212,650		
b. Adverse Impacts				
Project Costs				
Annual	$ 96,850*	$68,010*		
Maintenance Costs				
Annual	$ 18,000	$14,800		
TOTAL				
B/C Ratio	2.55	3.13	Not evaluated	
2. Environmental Quality				
a. Environmental Quality Enhanced	Stone breakwater would provide additional haven for aquatic life (1, 6, 9)	Same as Plan 1 but reduced in effect	Same as Plans 1 & 2, but reduced in effect	No change

*includes maintenance

Summary Comparison of Proposed Plans

TABLE 1 System of Accounts	PLAN 1 2100 Foot Pier	Plan 2 875 Foot Pier	PLAN 3 Short Pier	Plan 4 No Development
b. Environmental Quality Degraded	Temporary turbidity during construction; increase in noise during construction (1, 6, 9) Increased berthing may cause decreased quality of water and sediments w/in harbor (1, 6, 9)	Same as Plan 1 but reduced effect due to shortened pier length	Same as Plan but reduced effect due to shortened pier length	Deterioration of breakwater would cause adverse recreational, safety, and aesthetic effects
c. Environmental Quality Destroyed	Benthic habitat displaced by breakwaters (1, 6, 9)	Same as Plan 1 but less habitat displaced	Same as Plans 1 & 2, but less habitat displaced	No change
3. Social Well Being a. Beneficial Impacts Enhancement of Health, Safety, and Community Well Being	Would provide safe harbor of refuge, increase safety of boaters, provide increased use of shore facilities, increased community income, increased potential for future development; probable increase in work force to handle additional transients (1, 6, 9)	Same as Plan 1	Same as Plan 1	No change
b. Recreational Opportunities	Increased use of breakwater by sport fishermen; a safe harbor of refuge expected to attract more sportsmen to area.	Same as Plan 1	Same as Plan 1	No effect

Summary Comparison of Proposed Plans

TABLE 1 System of Accounts	PLAN 1 2100 Foot Pier	Plan 2 875 Foot Pier	PLAN 3 Short Pier	Plan 4 No Development
c. Adverse Impacts				
(1) Deterioration in quality of life, health, well-being	Temporary annoyances of construction activities (1, 6, 9)	Same as Plan 1 but reduced in severity	Same as Plans 2 & 4 but less impact	Continuation of present threat of damage from storm generated waves on berthed recreation craft; (1, 6, 9) as use of harbor increases, expected damages increase.
(2) Degraded Recreational Opportunities	Temporary interference with fishing in harbor (1, 6, 9)	Same as Plan 1 but reduced in severity	Same as Plans 1 & 2 but less interference	Harbor not useable during stormy periods; present breakwaters not functional.
(3) Injurious Displacement of People, Community Disruption	Tendency to replace present condition	Same as Plan 1	Same as Plan 1	Rough seas within harbor area (1, 6, 9). During periods of excessive harbor wave heights, berthed boats are subjected to damages; community reaction to prevent destruction of vessels (1, 6, 9)
4. Regional Development				
a. Benefical Impacts				
(1) Value of Increased Income	Increased income during construction (1, 6, 9)	Same as Plan 1	Same as Plan 1	No change

Summary Comparison of Proposed Plans

TABLE 1 System of Accounts	PLAN 1 2100 Foot Pier	Plan 2 875 Foot Pier	PLAN 3 Short Pier	Plan 4 No Development
(2) Quantity of Increased Employment	Limited employment during construction; increased demand for service would create seasonal employment opportunities (1, 6, 9)	Same as Plan 1	Same as Plan 1	No change
(3) Desirable Population Distribution	Increase in seasonal transients; possible moderate increase in local residency (2, 5, 9)	Same as Plan 1	Same as Plan 1	No change
(4) Increased Stability of Regional Economic Growth	Increased transients would extend economic capacity of region and stabilize seasonal variations of services (2,6,9) All other regional income and employment not evaluated	Same as Plan 1	Same as Plan 1	No change; possiblity that increase in recreational demand could be diverted from Cedar River Harbor because of (a) lack of safe berthing (b) lack of expanded facilities
b. Adverse Impacts (1) Value of Income Lost	No effect	No effect	No effect	Possibility of diversion of recreational interests to a harbor which provides safe berthing and suitable service facilities (1, 5, 10)

Summary Comparison of Proposed Plans

TABLE 1 System of Accounts	PLAN 1 2100 Foot Pier	Plan 2 875 Foot Pier	PLAN 3 Short Pier	Plan 4 No Development
(2) Quantity of Jobs Lost	No effect	No effect	No effect	Increased possiblity of loosing potential seasonal employment opportunities w/o harbor improvement (1, 5, 10)
(3) Undesirable Growth	No effect	No effect	No effect	No effect

Index of Footnotes:

Timing: 1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation).

Uncertainty: 4. The uncertainty associated with the impact is 50% or more.
5. The uncertainty is between 10% and 50%.
6. The uncertainty is less than 10% (impact is virtually certain).

Exclusivity: 7. Overlapping entry: fully monitized in NED account.
8. Overlapping entry: not fully monitized in NED account.

Actuality: 9. Impact will occur with implementation.
10. Impact will occur when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

Match Line A-A

Panoramic view of Cedar River Harbor and breakwater structures, lookin
photograph. Originally constructed in 1882, the stone filled, wooden
maintenance. The navigation light, extreme right, would be relocated
addition of a new navigation light for the head of the new east pier.

ures, looking east. Remnants of the old piers are seen in the bottom
ted, wooden pile structures have deteriorated because of a lack of
relocated to the head of the new west pier, in conjunction with the
east pier. (SEPT 1979)

15. HYDRAULIC ANALYSIS

The hydraulic investigation undertaken in connection with the preparation of this supplement was limited to a wave analysis at the Cedar River Harbor. This analysis included the calculation of deep water wave parameters, wave refraction and diffraction, wave runup on the structure, wave overtopping, and an assessment of the structure's impact on erosion patterns. A model study of the wave height characteristics was not undertaken.

16. Deep water wave parameters were determined for four wave directions and were calculated using the SMB technique as outlined in the Shore Protection Manual. These four directions were selected on the basis of fetch, general wind patterns, and alignment of the breakwater structures.

	Deep Water Wave Parameters	
Wave Direction	Wave Heights, Ft.	Wave Period, Secs.
ENE	6.1	5.3
E	8.0	6.1
SE	10.3	6.8
S	11.0	7.0

17. These parameters, along with hydrography of the area, were then used for input into a refraction computer program. The refraction and shoaling coefficients were calculated and used to determine wave conditions at the structure.

Wave Conditions After Diffraction and Shoaling	
Wave Direction	Wave Height, Ft.
ENE	4.5
E	7.5
SE	9.5
S	7.0

18. The diffraction of waves around the harbor structure would occur principally for waves from the east-northeast and east. The waves approaching from the southeast and south, because of the breakwater alignment, will enter the harbor without diffraction.

Diffracted Waves At The Harbor	
Wave Direction	Wave Height, Ft.
ENE	3.0
E	6.0
SE	9.5
S	7.0

19. Wave runup calculations, using a procedure outlined in the Shore Protection Manual, were based on an impermeable rubblemound structure and on deep water wave parameters. Three points of the structure were considered in calculating wave runup: the approximate lakeward end, the midpoint, and near shore points.

Wave Runup Data		
Wave Direction	Point on Structure	Runup. Ft.
ENE	Lake End	5.6
	Near Shore	5.1
E	Lake End	8.3
	Near Shore	7.6
SE	Lake End	10.2
	Near Shore	10.1
S	Lake End	—
	Near Shore	—

20. Wave overtopping volumes were calculated using a procedure outlined in the Shore Protection Manual. Transmitted wave heights of 1.2 feet or less were calculated using the method of Cross and Solitt.

21. The possible impact of the structure on erosion patterns within the area would depend on several parameters, including lake level, wind conditions, and soil conditions. Data on these parameters or the littoral environment, which could be used to evaluate the impact of the structure, is not available for this section of the Great Lakes. However, upon an examination of several aerial photographs and reports, the shoreline presently appears to be in an equilibrium condition.

22. The construction of the breakwaters will cause a minor shift in erosion patterns from this equilibrium condition. Available Littoral Environmental Observation program data provides an estimate of possible changes approximately one-half to one foot of recession a year could occur for one mile north and south of the structures. These rates can

very considerably depending on weather, lake and soil conditions. The extent of the change cannot be accurately estimated without more complete data or a model study.

DESCRIPTION OF PROPOSED STRUCTURE AND IMPROVEMENTS

23. GENERAL

This section includes general information pertinent to the features of the revised project plan. The project plans are shown on Drawings 1 through 5.

24. EAST PIER AND PIERHEAD

Modification of the east pier provides that the pier length proposed in General Design Memorandum No. 1 be decreased by approximately 1,230 feet. This shortening would require the removal of approximately 870 feet of the existing timber and stone pier structure. The length of the proposed pier is approximately 875 feet with an average top width of 8' which will be paved to form a recreational walkway for its entire length. The pier would be constructed primarily of riprap and cover stones with side slopes of 1 vertical to 2 horizontal. A free board of 6 to 8.5 feet* will be provided. A 12 foot square rubble mound pierhead with side slopes of 1 vertical to 2 horizontal will be constructed and include a concrete foundation for navigational lights.

25. WEST PIER AND PIERHEAD

The rehabilitation of the 230 foot long existing west pier includes the rebuilding of the pier with riprap cover stones to protect the existing navigation light base. The pierhead construction would also be similar to that of the east pier rubble mound structure.

*above LWD

26. CHANNEL DREDGING

A channel 10 feet deep and about 100 feet wide would be dredged from the 10 foot contour in Lake Michigan to the river mouth. From the river mouth upstream to just north of the turning basin (approximately 1,050 feet) a channel 8 feet deep and about 80 feet wide would be dredged within the river channel. A 150 foot wide turning basin would also be deepened as part of the project. Dredged materials would be placed on the beach immediately north of the east pier, if not contaminated.

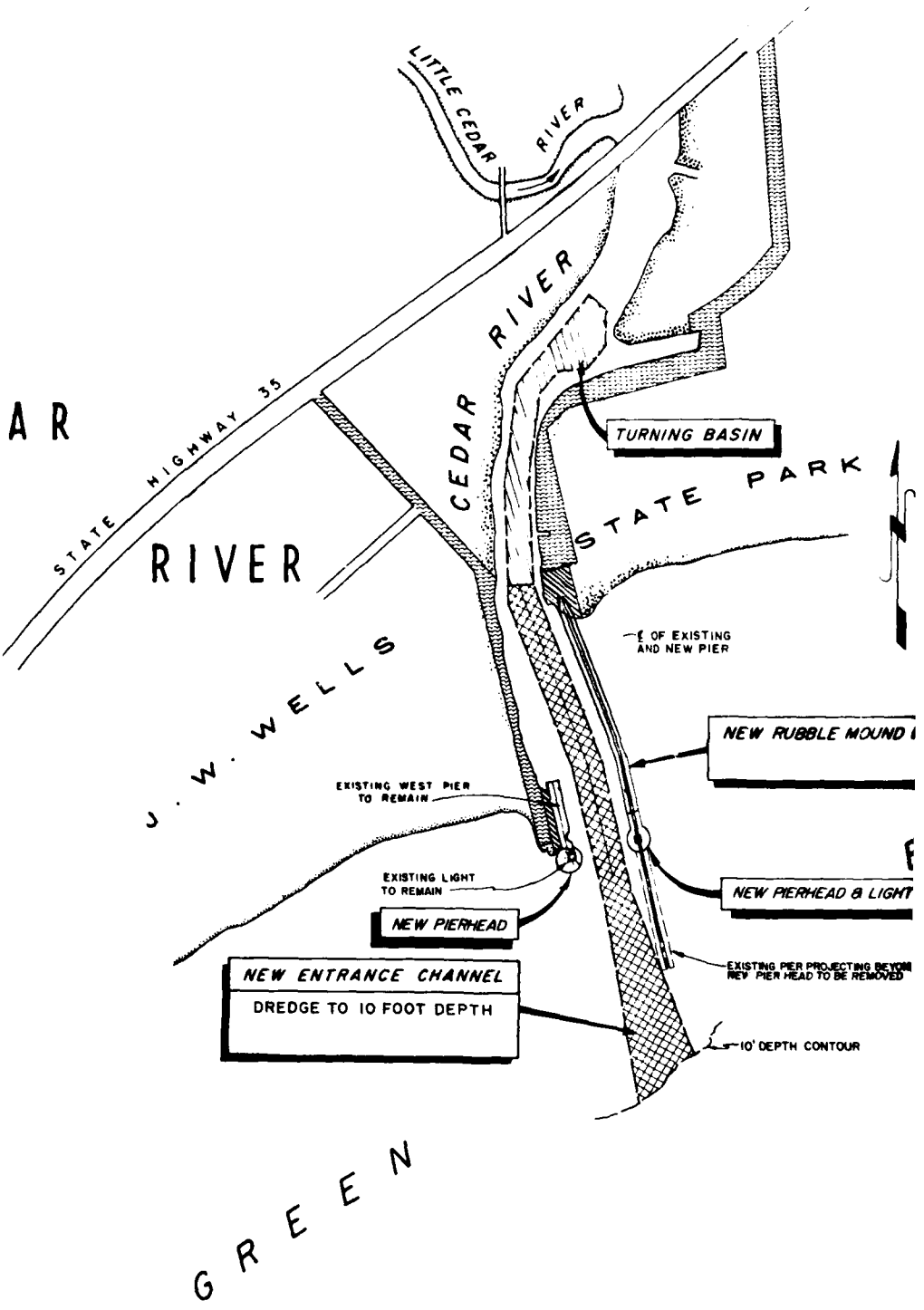
27. LOCAL COOPERATION REQUIREMENTS

The project is located on State owned lands. Because the Michigan Department of Natural Resources has expressed a desire to provide access for the fishing walkway on the proposed East Pier, ingress and egress to construct this project should be made available without difficulty as a part of the local cooperation requirements, which are as follows:

(1) Contribute in cash 15 percent of the first cost of the new navigation facilities and 50 percent of the first cost of structural modifications necessary to provide for a sport fishing walkway on top of the new east pier, the total of such contributions being presently estimated at $232,230, to be paid in a lump sum prior to initiation of construction, subject to final adjustment after actual costs have been determined;

(2) Provide without cost to the United States all lands, easements and rights-of-way required for the construction* and subsequent maintenance of the project and for aids to navigation upon the request of the Chief of Engineers including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil, and necessary retaining dikes, bulkheads, and embankments therefor or the cost of such retaining works;

*See following Plate, "Real Estate Requirements"



PLAN

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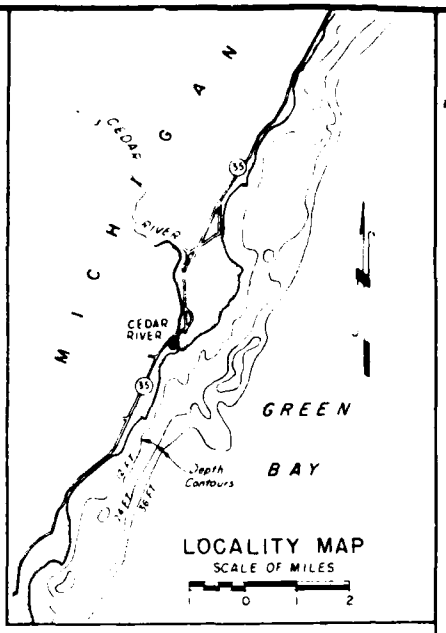
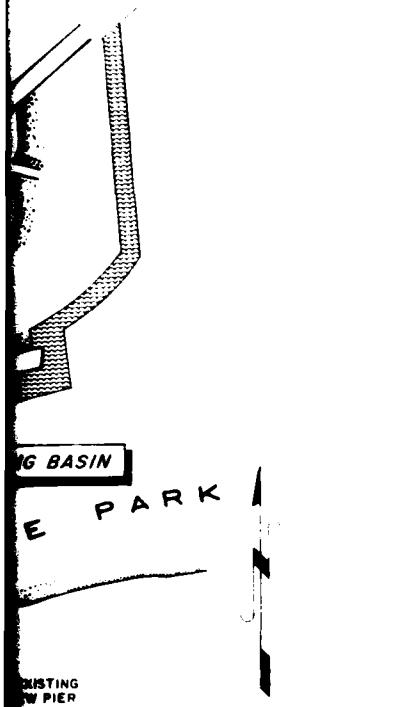
SCALE IN FEET

U.S. ARMY





LEGEND

PERMANENT EASEMENT FOR PIER CONSTRUCTION

TEMPORARY EASEMENT FOR ACCESS TEMP. CONSTRUCTION* AND STORAGE.

* TEMPORARY CONSTRUCTION OF IMPROVED ACCESS ROADS SHALL BE ACCOMPLISHED ONLY ON EXISTING ROADS / LANES. STORAGE WILL BE ALLOWED RIVERWARD OF ACCESS LANES (IN NON-WETLAND AREAS) AND IN THE RIVER OR BAY.

NOTES
1. MATERIAL TO BE DREDGED IS SUITABLE FOR OPEN WATER DISPOSAL AND WOULD BE DEPOSITED ALONG THE BEACH, EITHER SIDE OF THE PIERS.
2. AN UPLAND DISPOSAL SITE FOR DEBRIS FROM THE REMOVAL OF THE EAST PIER WILL BE IDENTIFIED WHEN AVAILABLE (STATE OWNED LAND).

INDEX TO DRAWINGS

SHEET NO.	DESCRIPTION
1	PLAN, LOCALITY AND VICINITY MAPS, AND INDEX TO DRAWINGS
2	STA TO AND LOCATION OF BORINGS
3	STA TO AND LOCATION OF BORINGS
4	CHANNEL SECTIONS
5	PLAN AND SECTIONS

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
DETROIT, MICHIGAN

PREPARED BY:
DRAWN BY
CHECKED BY

CEDAR RIVER HARBOR
CEDAR RIVER, MICHIGAN
RUBBLE MOUND PIER AND CHANNEL DREDGING AND PIER PLAN
REAL ESTATE REQUIREMENTS

1 2

(3) Hold and save the United States free from damages due to the construction works and maintenance of the project except for damages due to the fault or negligence of the Government or its contractors;

(4) Provide and maintain without cost to the United States necessary mooring facilities and utilities, including an adequate public landing or wharf with provision for the sale of motor fuel, lubricants, and potable water, and a parking lot with adequate sanitary facilities, available to all on equal terms and including the dredging of berthing areas to depths commensurate with the related project depths;

(5) Reserve anchorage spaces and mooring facilities adequate for the accommadation of transient craft; and

(6) Comply with the applicable provisions of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970", Public Law 91-646, approved 2 January 1971, in acquiring lands, easements, rights-of-way and spoil disposal area necessary for the construction and subsequent maintenance of the project.

COST ESTIMATES

28. GENERAL

The current estimated cost of the various elements comprising the project, including contingencies, engineering and design, supervision and administration are all based on August, 1979, price levels.

The estimate is based on an updated cost estimate of the General Design Memorandum No. 1 and revised to incorporate recommended revisions. A summary of total costs for the project is as follows:

Federal	$1,074,070
Non-Federal	232,230
Federal & Non-Federal	$1,306,300

29. ESTIMATE OF FIRST COSTS

The estimated first costs for the considered improvements are shown in Appendix F (see Tables F-1 and F-2). The costs are based on August, 1979 price levels and include estimates for engineering and design activities, and supervision and administration functions. Accordingly, the costs have been identified as either Federal or Non-Federal contributions.

First Costs

Channel Dredging	$ 230,000
Breakwater	631,800
Removal of Existing Stone/Timber Piles	51,000
Fishermen's Walkway	57,000
Miscellaneous Construction	6,800
Total Construction Costs	$ 976,600
Engineering and Design	215,000
Supervision and Administration	83,000
Subtotal	1,274,600
Right-of-Way	15,000
Aid to Navigation	16,700
Total Project First Costs	$1,306,300

30. APPORTIONMENT OF COSTS AMONG INTERESTS

The apportionment of First Costs between the United States (Federal) and local interests (Non-Federal) is presented in the following tabulation (see Appendix E for apportionment of costs of authorized plan).

Apportioned First Costs

Federal

General Navigation Facilities	$ 1,019,930
Sport Fishing	37,440
Aids to Navigation	16,700
Total Federal First Costs	$ 1,074,070

Non-Federal

General Navigation Facilities, cash contribution	$ 179,790
Right-of-way	15,000
Sport Fishing	37,440
Total Non-Federal First Costs	$ 232,230
TOTAL FIRST COSTS (Federal + non-Federal)	$1,306,300

31. COMPARISON OF COST ESTIMATES

A comparison of costs between the August 1968 General Design Memorandum and the current revised project is presented in the table on page 21.

SCHEDULE OF DESIGN AND CONSTRUCTION

32. GENERAL

The design and construction of the project would continue for two construction seasons. The schedule of design and construction, subject to the availability of construction funds, is as follows:

Plans & Specifications to NCD.....March 1981
Advertizing Date.....November 1981
Bid Opening Date.....December 1981
Date of Contract Award.....January 1982
Construction Period.....April 1982 to December 1983

33. FUNDING SCHEDULE

a. Funds appropriated to date:

Appropriation through FY 1978	$ 49,800
FY 1979	$100,000

COMPARISON OF COST ESTIMATES

ITEM	PROJECT DOCUMENT ESTIMATE $1,000	GDM ESTIMATE $1,000	ESTIMATE LAST PRESENTED TO CONGRESS (OCT 1978) $1,000	REVISED PROJECT ESTIMATE AUGUST 1980 PRICE LEVEL $1,000	COST DIFFERENCE BETWEEN AUTHORIZED ESTIMATE AND REVISED PROJECT ESTIMATE $1,000	EXPLANATION
Federal Cost						
Channel	64.6* (208.7)	103.9** (272.0)	255.0 (272.9)	195.5	+130.9 (-13.2)	Net increase due to price level changes.
Breakwater	523.6 (1691.2)	434.5 1165.0)	1092.0 (1168.4)	537.2	+13.6 (-1154.0)	Nominal resultant increase due to shortened breakwater length and increase in price level change.
Miscellaneous Construction	-	-	-	49.1	+49.1 (+49.1)	Net increase due to greater design detail.
Recreation Facilities	4.0 (12.9)	6.0 (17.0)	16.0 (17.1)	28.5	+24.5 (+15.6)	Net increase due to greater design detail.
Engineering and Design	27.0 (87.2)	42.9 (164.0)	118.0 (126.3)	99.3	+151.3 (+91.1)	Net increase due to greater design detail.
Supervision and Administration	44.8 (144.7)	42.0 (132.0)	129.0 (138.0)	68.9	+24.1 (-75.8)	Net increase due to increased project cost.
Aid to Navigation	3.0 (9.7)	8.5 (25.0)	25.0 (26.8)	16.7	+13.7 (+7.0)	Net increase due to price level changes.
Subtotal	667.8 (2154.4)	637.8 (1775.0)	1635.0 (1749.5)	1074.1	+407.3 (-1080.2)	

*Top figure represents 1964 price level, bottom figure represents 1980 price level.
**Top figure represents 1968 price level.

COMPARISON OF COST ESTIMATES (Cont'd.)

ITEM	PROJECT DOCUMENT ESTIMATE $1,000	GDM ESTIMATE AUGUST, 1968 GDM PRICE LEVEL $1,000	ESTIMATE LAST PRESENTED TO CONGRESS (OCT 1978) $1,000	REVISED PROJECT ESTIMATE AUGUST 1980 PRICE LEVEL $1,000	COST DIFFERENCE BETWEEN AUTHORIZED ESTIMATE AND REVISED PROJECT ESTIMATE $1,000	EXPLANATION
Non-Federal Cost						
Channel	11.4* (36.8)	18.3* (48.0)	45.0 (48.2)	34.5	+23.1 (-2.3)	Net increase due to price level changes.
Breakwater	92.4 (298.5)	76.7 (205.0)	193.0 (206.5)	94.6	+2.2 (-203.9)	Nominal resultant increase due to shortened breakwater length and increase in price level change.
Right-of-Way				15.0	+15.0 (+15.0)	Net increase due to statutory requirements
Miscellaneous Construction	-	-	-	8.7	+8.7 (+8.7)	Net increase due to greater design detail.
Recreation Facilities	4.0 (12.9)	6.0 (17.0)	16.0 (17.1)	28.5	+24.5 (+15.6)	Net increase due to greater design detail.
Engineering and Design	5.0 (16.2)	7.8 (31.0)	22.0 (23.5)	36.7	+31.7 (+20.5)	Net increase due to greater design detail.
Supervision and Administration	8.2 (26.5)	7.9 (24.0)	24.0 (25.7)	14.1	+5.9 (-12.4)	Net increase due to increased project
Subtotal	121.0 (390.9)	116.7 (325.0)	300.0 (321.0)	232.1	+111.1 (-158.8)	
TOTAL	788.0 (2,545.3)	754.5 (2,100.0)	1935.0 (2070.5)	1306.2	+518.4 (-1239.1)	

*Top figure represents 1964 price level, bottom figure represents 1980 price level.
**Top figure represents 1968 price level.

b. Funds required to complete:

First Construction year	$271,600
Second Construction year	$590,900

34. OPERATION AND MAINTENANCE

The present harbor at Cedar River was recommended for abandonment in 1926, but no action was taken by Congress. The project adopted in 1882, which included dredging of a channel and the construction of two piers, was completed in 1886. No work has been done since, so that the facilities have deteriorated such that protection to small craft can no longer be provided. Because there has been no expenditure for maintenance, no average annual costs can be determined. However, it is estimated that annual maintenance dredging for the work, expected to occur every two years, would cost $2,500. The annual cost of pier maintenance including recreational walkway is estimated to be $11,600, and the annual maintenance cost of aids to navigation is estimated at $700. The total annual operation and maintenance cost is estimated at $14,800.

ESTIMATE OF BENEFITS

35. GENERAL

The considered plan of improvement is expected to benefit recreational boating and light-draft commercial fishing through improvement of navigation facilities. Benefits accruing to recreational boating are estimated for the boats anticipated to use the harbor improvements and are based on the depreciated values of the boats. Construction of adequate entrance and inner channels would increase the value of the harbor for refuge, by providing temporary anchorage and shelter to small recreational and commercial fishing boats on Green Bay during periods of storm. Additional project benefits would accrue to sport fishing enthusiasts who would be able to fish from the new east pier. Menominee County, Michigan, had been

designated for redevelopment under the Area Redevelopment Act of May 1, 1961, however, the designation was terminated in 1966.

36. ESTIMATE OF ANNUAL CHARGES

Estimated average annual charges for the considered plan of improvement are presented in Table I. The time required for construction is estimated to be two years, although no allowance was made for interest during construction in determining Federal investment costs. Interest is assumed at 3-1/4 percent on both Federal and non-Federal costs. Amortization is based on an assumed project life of 50 years.

37. SUMMARY OF BENEFITS

The estimated average annual benefits attributable to each alternative are summarized in Table II. The type of benefits are identified as recreational craft, harbor of refuge, sport fishing, and commercial fishing.

38. JUSTIFICATION

Through a comparison of the estimated average annual costs and benefits for each alternative (Table III), it is shown that each alternative is economically justified. The benefits exceed the costs for alternative 1 with a benefit-cost ratio of 2.55 to 1, and net benefit of $149,640, while the benefit-cost ratio for alternative 2 is 3.13 to 1 with net benefits of $144,640.

TABLE 1

ESIMATED AVERAGE ANNUAL CHARGE

INVESTMENT COSTS	Total Alternative 1	Alternative 2
Federal First Cost	$1,635,000	$1,074,070
Non-Federal First Cost	300,000	232,230
TOTAL FEDERAL AND NON-FEDERAL COST	$1,935,000	$1,306,300
ANNUAL CHARGES		
FEDERAL		
Interest (.0325)	$ 53,000	$ 34,910
Amortization (.00823)	13,450	8,840
Maintenance	18,000	14,800
TOTAL	$ 84,600	$ 58,550
NON-FEDERAL		
Interest (.0325)	$ 9,750	$ 7,550
Amortization (.00823)	2,500	1,910
Maintenance	0	0
TOTAL	$ 12,250	$ 9,460
TOTAL ANNUAL CHARGES	$ 96,850	$ 68,010

TABLE II
SUMMARY OF BENEFITS

TYPE OF BENEFIT	Total Alternative 1	Alternative 2
RECREATIONAL CRAFT		
a. Locally based craft before construction	$ 26,070	$ 26,070
b. Locally based boats after construction	45,720	45,720
c. Transient based boats after construction	28,460	28,460
HARBOR OF REFUGE	5,550	5,550
SPORT FISHING	71,000	37,190
COMMERCIAL FISHING	69,660	69,660
TOTAL BENEFITS	$246,460	$212,650

TABLE III

COMPARISON OF BENEFITS AND COSTS

Improvement	Annual Benefit	Annual Cost	Benefit-Cost Ratio	Net Benefit (B-C)
Cedar River Harbor				
Alternative 1	$246,460	$ 96,850	2.55	$149,640
Alternative 2	$212,650	$ 68,010	3.13	$144,640

39. BENEFIT TO COST RATIO

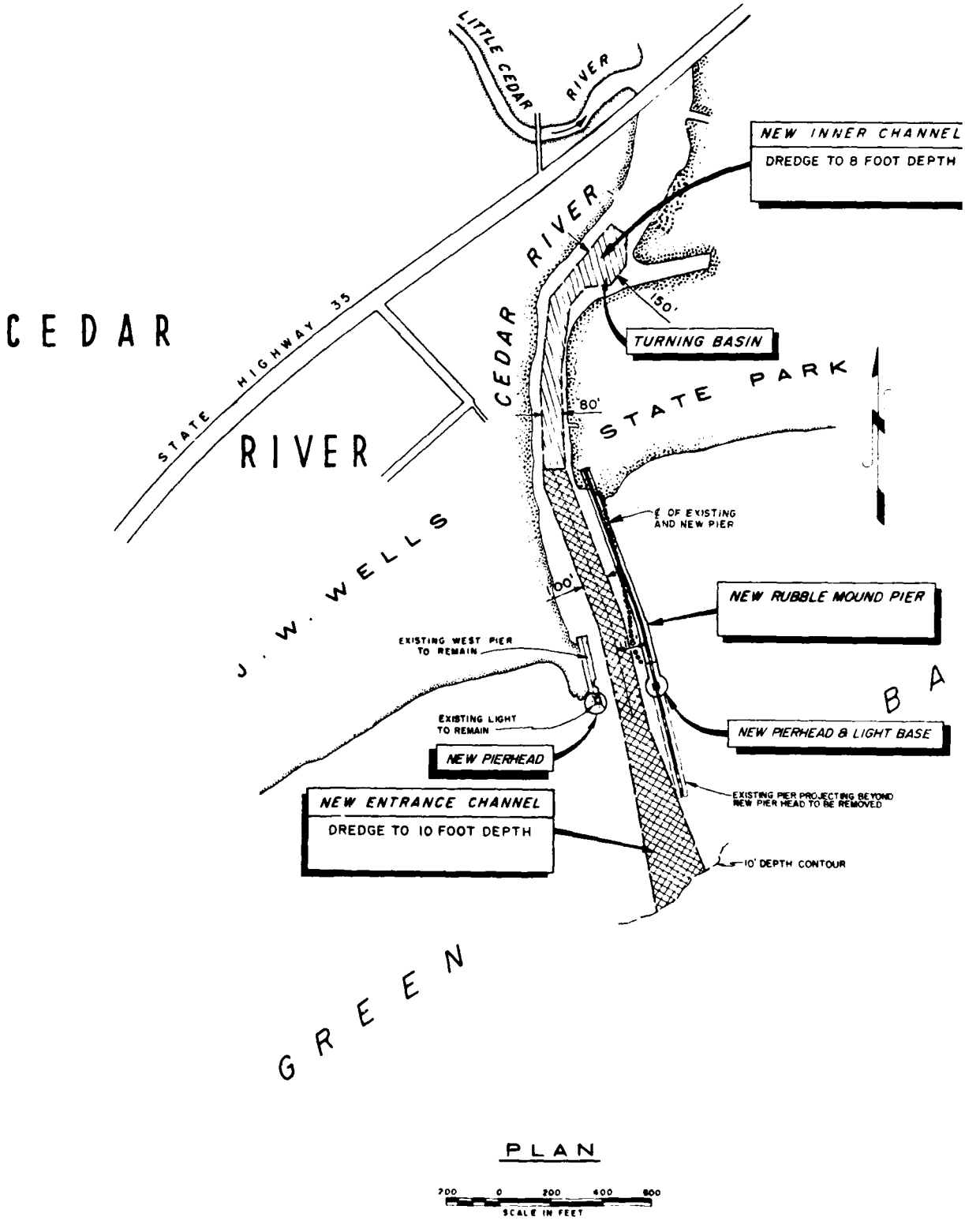
A comparison of annual benefits to annual costs for the proposed improvement indicates that the total project is justified by a ratio of 3.13 to 1, as shown in Table III. Separate comparisons for navigation facilities and for recreational (sport fishing) facilities show that each is also individually justified.

40. RECOMMENDATIONS

It is recommended that the project plan as presented in the General Design Memorandum No. 1, for improvements of the Cedar River Harbor be revised to incorporate modifications as presented in this Supplement, namely, shortening the east pier and rehabilitating the west pier which includes the construction of a new pierhead around the existing navigation light base.

ROBERT V. VERMILLION
Colonel, Corps of Engineers
District Engineer

CORPS OF ENGINEERS



PLAN

200 0 200 400 800

SCALE IN FEET

U.S. ARMY

NEW INNER CHANNEL
DREDGE TO 8 FOOT DEPTH

SIN
PARK

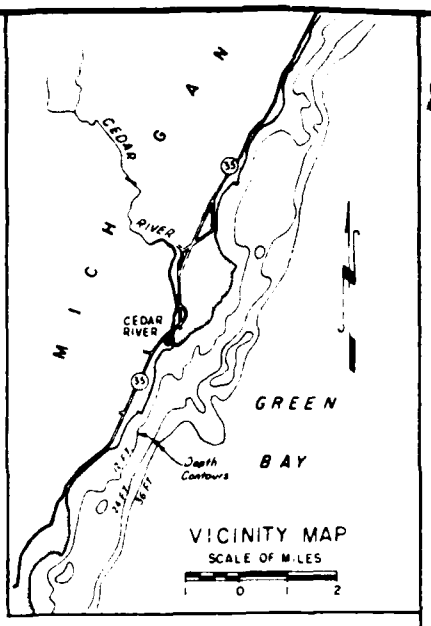
EW RUBBLE MOUND PIER

B A Y

EW PIERHEAD & LIGHT BASE

TING PIER PROJECTING BEYOND
PIER HEAD TO BE REMOVED

'0' DEPTH CONTOUR



INDEX TO DRAWINGS

SHEET NO.	DESCRIPTION
1	PLAN, LOCALITY AND VICINITY MAPS, AND INDEX TO DRAWINGS
2	STA TO AND LOCATION OF BORINGS
3	STA TO AND LOCATION OF BORINGS
4	CHANNEL SECTIONS
5	PLAN AND SECTIONS

REVISION	DATE	DESCRIPTION	BY

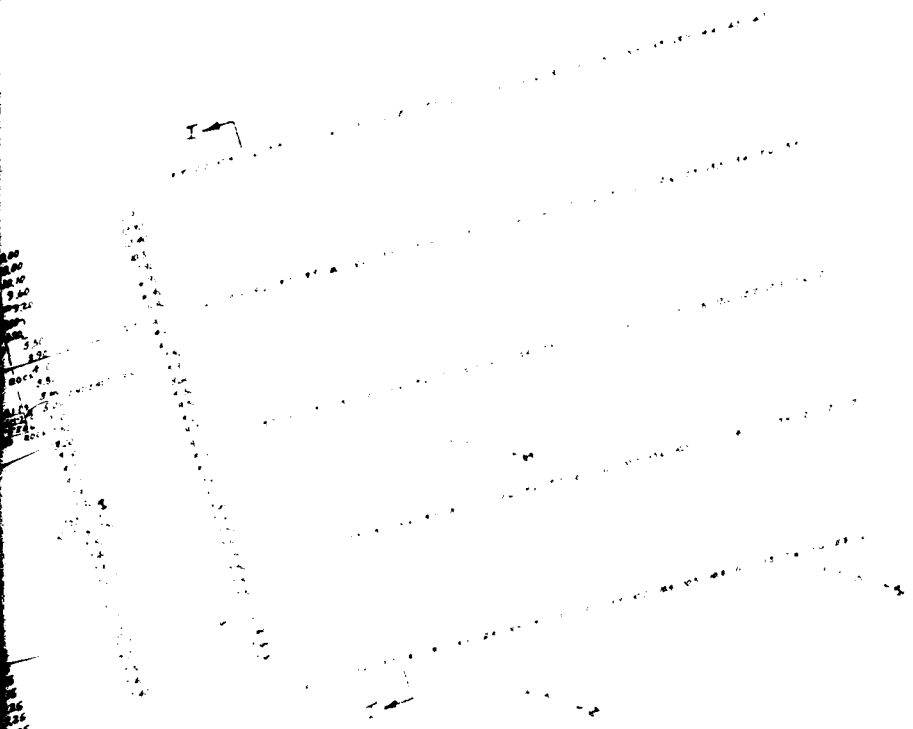
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
DETROIT, MICHIGAN

PREPARED BY:
DRAWN BY:
CHECKED BY
SUBMITTED BY
APPROVAL RECOMMENDED: DATE:
ASST. CHIEF, ENG DIV., CHIEF, ENGINEERING DIVISION
APPROVED:
COLONEL, CORPS OF ENGINEERS, DISTRICT ENGR.

CEDAR RIVER HARBOR
CEDAR RIVER, MICHIGAN
RUBBLE MOUND PIER AND CHANNEL DREDGING AND PIER PLAN
PLAN, LOCALITY & VICINITY MAP AND INDEX TO DRAWINGS

SCALE: AS SHOWN
SHEET 1
FILE NO. 31-82


SHEET NO 3
9TA
MATCH LINE



DESCRIPTION OF BENCHMARKS

B.M. NO. [illegible] — AT CEDAR RIVER, MICHIGAN AT NORTHEAST CORNER OF UPPER BASE BLOCK OF SOUTH PIER LIGHT. ELEVATION 8.47 L.W.D.

T.B.M. — CHISELED SQUARE ON LOWER LEDGE SOUTHEAST CORNER CONCRETE GUARD WALL SOUTHEAST CORNER ROUTE M-35 BRIDGE OVER CEDAR RIVER. ELEVATION 14.99 L.W.D.

B.M. NO. 3254 - STANDARD CORPS OF ENGINEERS BRASS CAP SET IN CENTER LINE ROUTE M-35 EAST OF EAST END OF BRIDGE OVER CEDAR RIVER. STAMPED STA. 32+54 1967. ELEVATION 14.02 L.W.D.

NOTES:

1. ALL STATIONING REFER TO CEDAR RIVER AND HARBOR SURVEY BASELINE AND ARE PERPENDICULAR TO THIS BASELINE.
2. SOUNDINGS ARE IN FEET AND ARE REFERRED TO LOW WATER DATUM 576.8 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (INTERNATIONAL GREAT LAKES DATUM 1955).
3. FOR DREDGING SECTIONS, SEE SHEET 4.
4. FOR LOGS OF BORINGS, SEE APPENDIX A.
5. FOR DETAILS OF PIERHEAD AND LIGHT BASE AND RUBBLE MOUND PIER SEE SHEET 5.

COORDINATES TABLE

STATION	DESCRIPTION	DISTANCE AND BEARING FROM OR ALONG BASELINE	BEARING	DISTANCES	COORDINATES IN FEET NORTH	EAST
0+00 N					22,469.49	1,810,150.88
			N 51° 46' 22" W	1578.9'		
15+27 N					23,796.49	1,809,755.97
	POINT 1					
	POINT 10					
	POINT 2					
	POINT 8					

U.S. ARMY ENGINEER DISTRICT, DETROIT
CORPS OF ENGINEERS

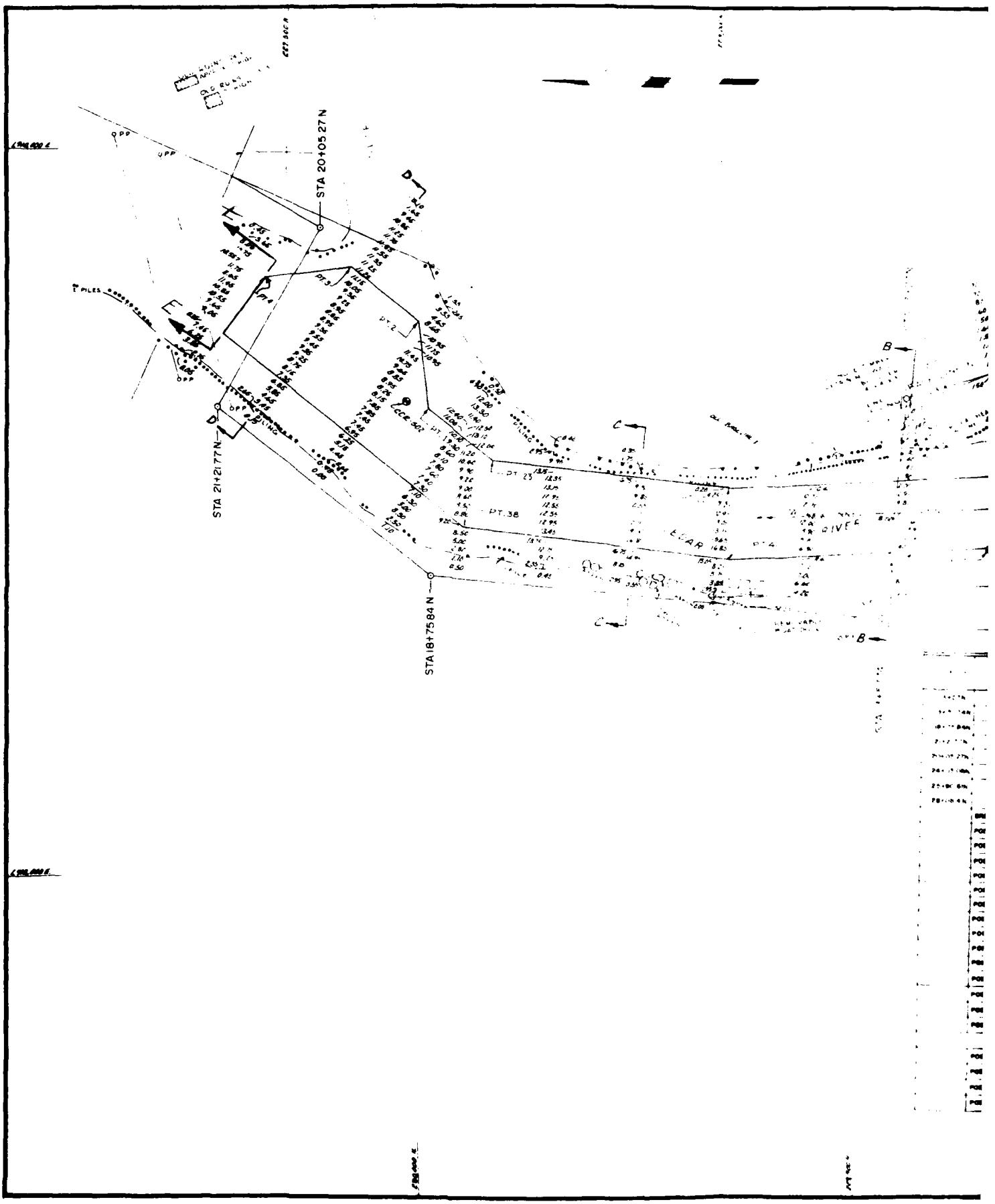
CEDAR RIVER HARBOR
CEDAR RIVER, MICHIGAN
RUBBLE MOUND PIER AND CHANNEL DREDGING AND PIER PLAN
STA. TO STA.
AND LOCATION OF BORINGS

CHIEF, DESIGN BRANCH | ASST. CHIEF, ENGINEERING DIVISION

SHEET NO. 2

INVITATION NO. DACW

CORPS OF ENGINEERS



U S ARMY

COORDINATES TABLE

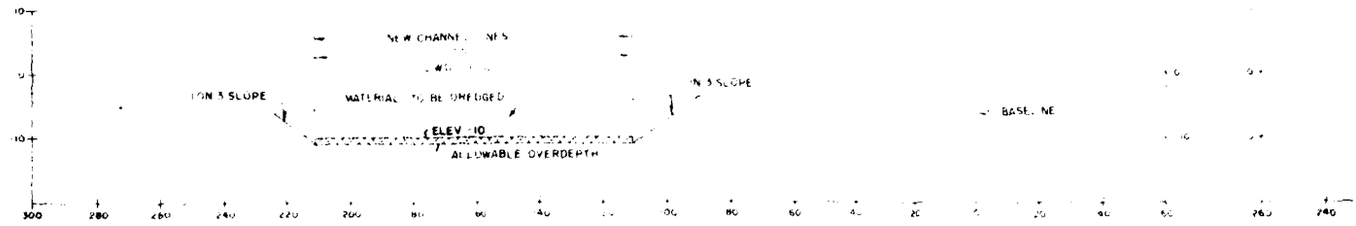
			BEARING	DISTANCE	COORD. NO. EASTING	COORD. NO. NORTH
1+27 N		0.00			228,796.48	909,756.87
13+77.74 N		0.00	N 84° 08' 53" W	25.31	228,822.26	909,505.84
18+75.84 N		0.00	N 05° 53' 10" E	525.77	229,345.26	909,559.8
21+27.7 N		0.00	N 37° 28' 43" E	310.03	229,581.29	909,748.47
24+05.77 N		0.00	S 60° 10' 01" E	234.19	229,474.79	909,957.23
24+05.77 N		0.00	N 29° 49' 17" E	456.54	229,872.61	910,180.26
25+91.61 N		0.00	N 04° 08' 27" W	188.24	230,060.14	910,196.58
28+18.4 N		0.00	N 08° 09' 07" E	226.0	230,27793	910,227.7
	BRASS CAP E RTE M 35	0.00				
	POINT 19	70.00	N 22° 02' 50" W	615.00		
	POINT 21	127.00	N 03° 02' 50" W	360.00		
	POINT 22	132.00	N 08° 57' 10" E	275.00		
	POINT 23	38.00	N 38° 24' 40" E	408.87		
	POINT 24	68.00	N 28° 57' 10" E	305.00		
	POINT 25	85.00	N 01° 32' 50" W	170.00		
	POINT 26	88.00	S 88° 27' 10" W	80.00		
	POINT 27	168.00	S 01° 32' 50" E	149.88		
	POINT 34	183.00	S 28° 57' 10" W	278.87		
	POINT 38	190.01	S 38° 24' 40" W	425.37		
	POINT 39	80.00	S 08° 57' 10" W	305.93		
	POINT 40	50.00	S 01° 02' 50" E	441.80		
	POINT 42	224.00	S 22° 02' 50" E	583.77		
	POINT 20	172.00				
	TURNING BASIN					
	POINT 1	147.00	N 83° 24' 40" E	98.99		
	POINT 2	219.00	N 38° 24' 40" E	100.00		
	POINT 3	220.00	N 08° 35' 20" W	98.99		
	POINT 4	80.00				

DESCRIPTION | BY

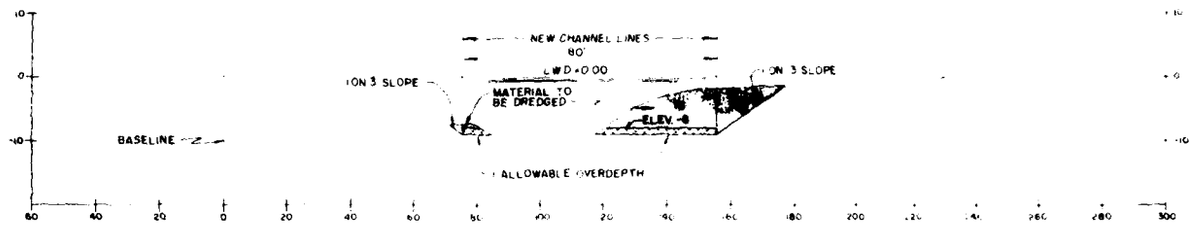
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
DETROIT, MICHIGAN

PREPARED BY | DRAWN BY | CHECKED BY | SUBMITTED BY | APPROVED: RECOMMENDED | DATE | CHIEF DESIGN BRANCH | ASST CHIEF, ENGINEERING DIV | APPROVED: | CHIEF, ENGINEERING DIV | SCALE 1" = 80'-0" | SHEET 3 | 31-82

CEDAR RIVER HARBOR
CEDAR RIVER, MICHIGAN
RUBBLE MOUND PIER AND CHANNEL
DREDGING AND PIER PLAN
STA TO STA.
AND LOCATION OF BORINGS



SECTION A-A



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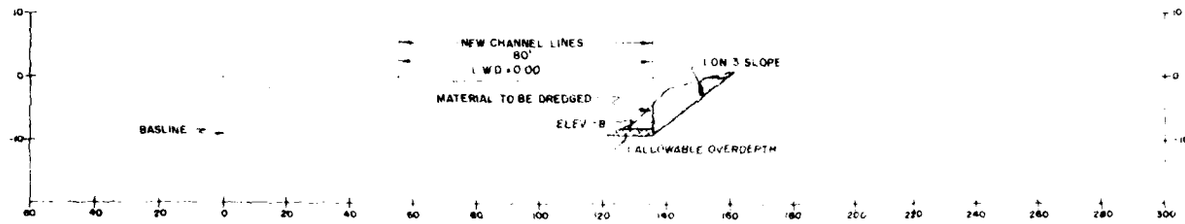
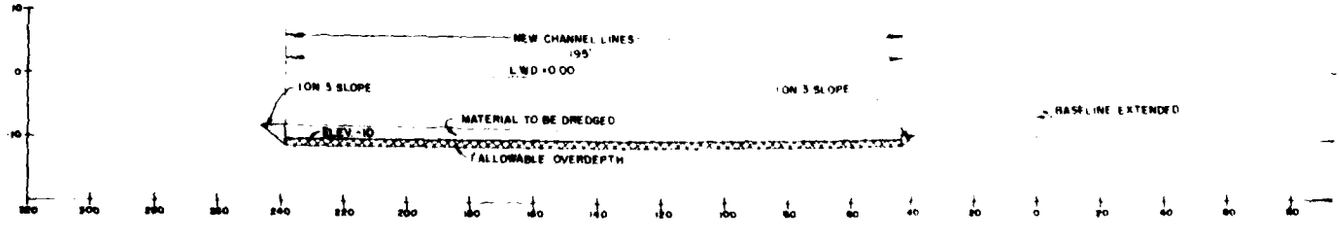
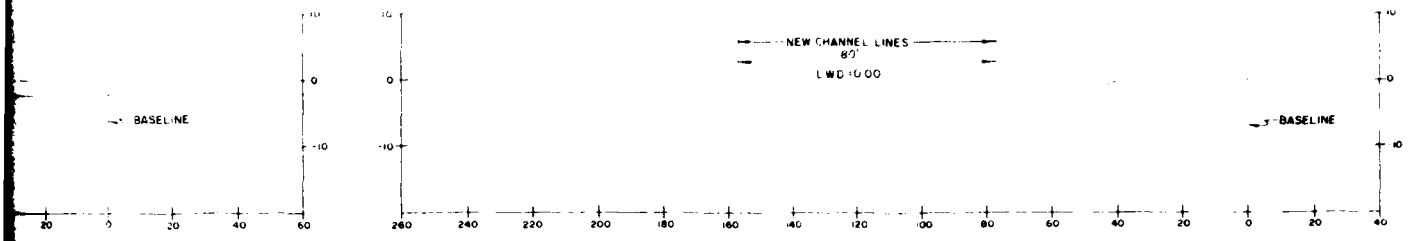


SECTION C-C

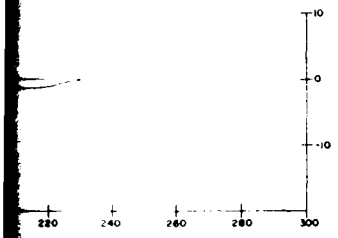
SECTION D-D

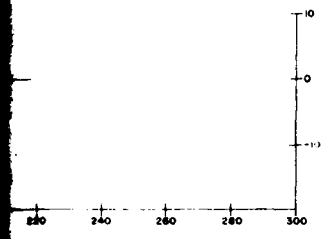


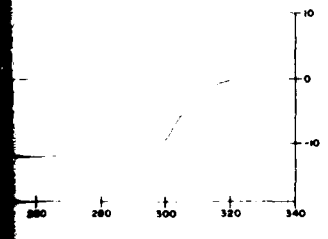
SECTION I-I



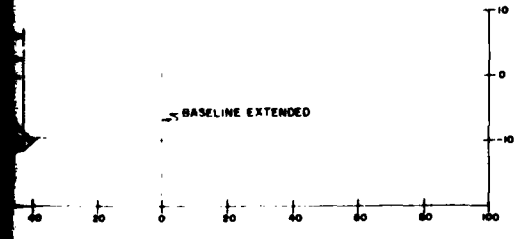
SECTION E-E







SECTION H-H



NOTES:
1. FOR LOCATIONS OF SECTIONS, SEE SHEETS 2 & 3
2. FOR DETAILS OF RUBBLE MOUND PIER, SEE SHEET 5
3. ELEVATIONS ARE IN FEET AND ARE REFERRED TO LOW WATER DATUM 576.8 FEET ABOVE MEAN WATER LEVEL FATHER POINT, QUEBEC (INTERNATIONAL GREAT LAKES DATUM 1955)

U.S. ARMY ENGINEER DISTRICT, DETROIT
CORPS OF ENGINEERS
DETROIT, MICHIGAN

CEDAR RIVER HARBOR

CEDAR RIVER, MICHIGAN
RUBBLE MOUND PIER AND CHANNEL DREDGING AND PIER PLAN

CHANNEL SECTIONS

CHIEF, DESIGN BRANCH | ASST CHIEF, ENGINEERING DIVISION

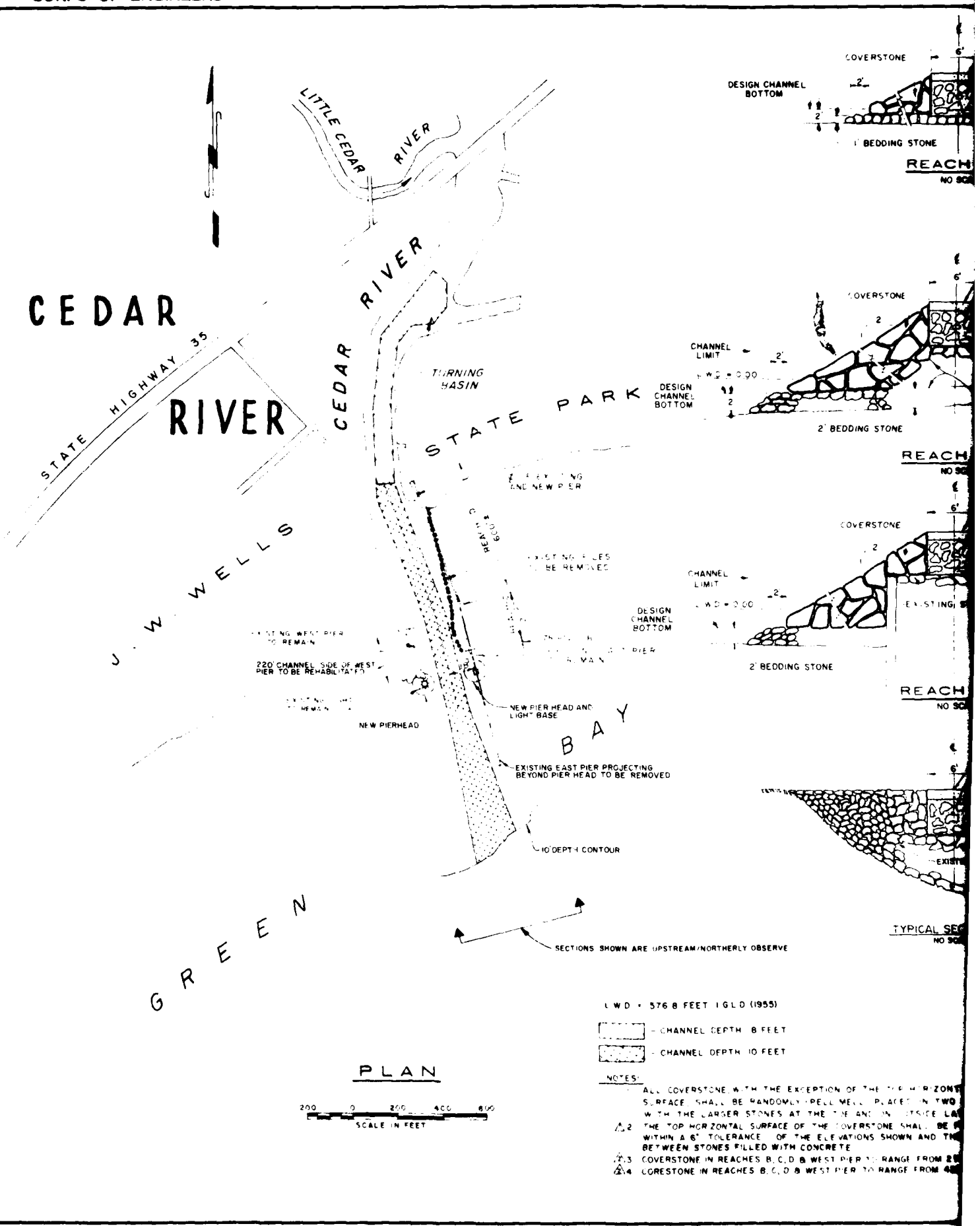
SCALE: 1" = 20 HORIZ & 1" = 10 VERT

4

31-RR

DACW

INVITATION NO DACW



PLAN

SCALE IN FEET

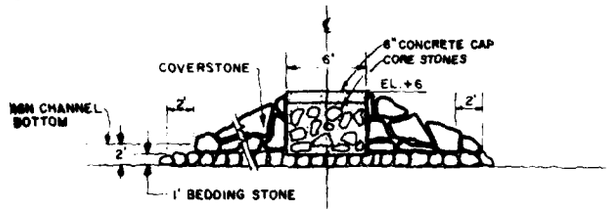
L W D = 576.8 FEET I G L D (1955)

- CHANNEL DEPTH 8 FEET
- CHANNEL DEPTH 10 FEET

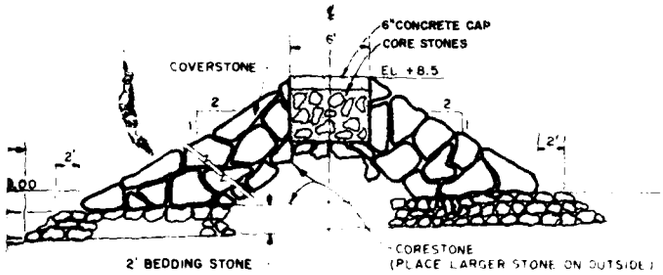
NOTES:

1. ALL COVERSTONE, WITH THE EXCEPTION OF THE TOP HORIZONTAL SURFACE, SHALL BE RANDOMLY WELL MIXED, PLACED IN TWO LAYERS WITH THE LARGER STONES AT THE TOE AND IN OUTSIDE LAYER.
2. THE TOP HORIZONTAL SURFACE OF THE COVERSTONE SHALL BE PLACED WITHIN A 6" TOLERANCE OF THE ELEVATIONS SHOWN AND THE VOIDS BETWEEN STONES FILLED WITH CONCRETE.
3. COVERSTONE IN REACHES B, C, D & WEST PIER TO RANGE FROM 2 TO
4. CORESTONE IN REACHES B, C, D & WEST PIER TO RANGE FROM 40

U.S. ARMY



REACH - D
NO SCALE



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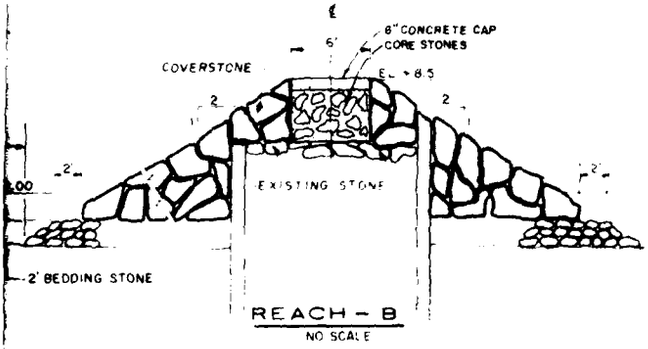

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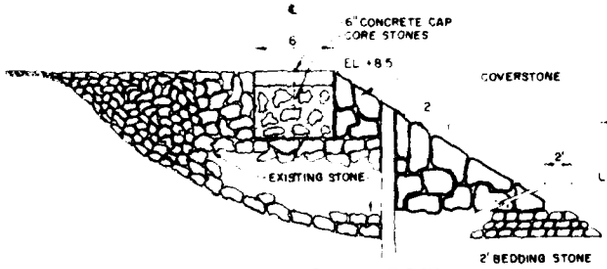
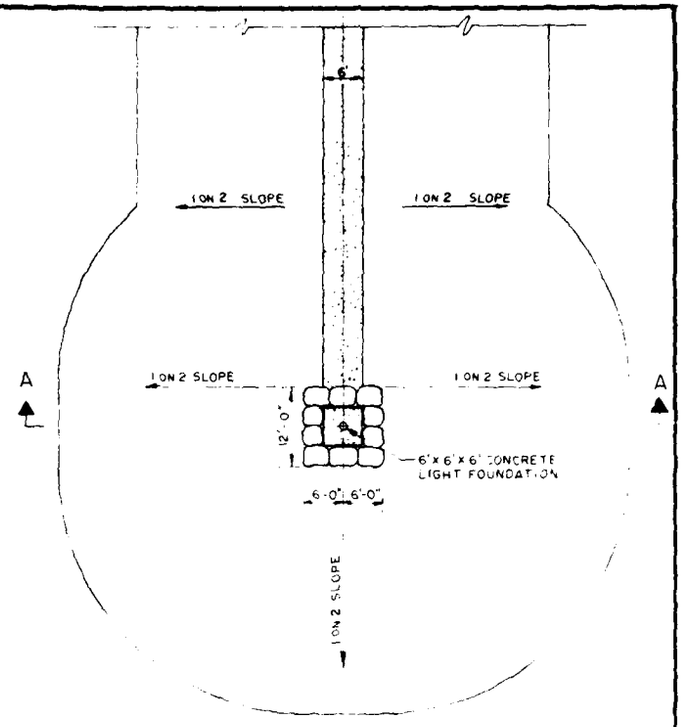
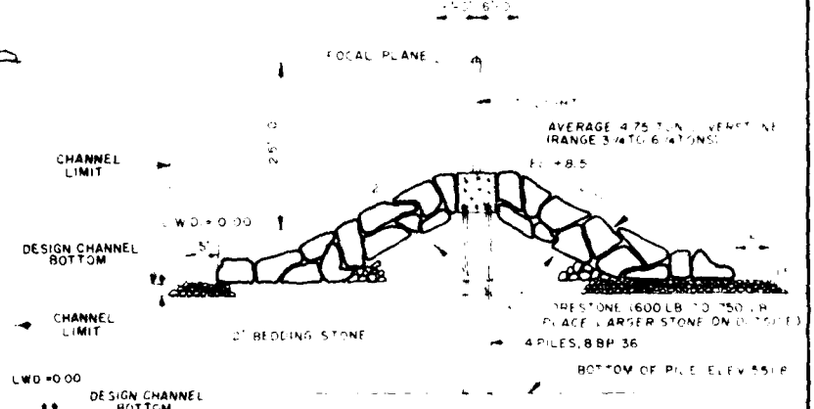


TYPICAL SECTION WEST PIER
NO SCALE



PLAN OF PIERHEAD
SCALE 1" = 10'-0"



SECTION - A - A
SCALE 1" = 10'-0"

LY OBSERVE

D (1955)

8 FEET

10 FEET

ITH THE EXCEPTION OF THE TOP HORIZONTAL
E RANDOMLY (PELL MELL) PLACED IN TWO LAYERS
STONES AT THE TOE AND ON OUTSIDE LAYER
L SURFACE OF THE COVERSTONE SHALL BE PLACED
ANCE OF THE ELEVATIONS SHOWN AND THE VOIDS
FILLED WITH CONCRETE
ONES B, C, D & WEST PIER TO RANGE FROM 2 ½ TO 4 ½ TONS
NES B, C, D & WEST PIER TO RANGE FROM 425 TO 1250 LBS

1" = 10'-0"

1" = 20'-0"

GRAPHIC SCALE

REFERENCE SHEET

3-24-80 ADDED NOTES 3 & 4, STONE CHANGES & CHANNEL REVISONS
ADDED NOTE 2

U.S. ARMY ENGINEER DISTRICT
DETROIT, MICHIGAN

CEDAR RIVER HARBOR
CEDAR RIVER, MICHIGAN
RUBBLE MOUND PIER AND CHANNEL
DREDGING AND PIER PLAN

PLAN & SECTIONS

DRAWN BY

TRACED BY

CHECKED BY

APPROVED

CHIEF, ENGINEERING DIVISION

SCALE AS SHOWN

SHEET 5

51 82

Appendix A

SOILS & GEOLOGY

SUPPLEMENT NO. 1

REVISIONS TO APPENDIX A

SOILS AND GEOLOGY

CEDAR RIVER HARBOR, MICHIGAN

TABLE OF CONTENTS

PLATES

Plate Number

SUPPLEMENT NO. 1
REVISIONS TO APPENDIX A
SOILS AND GEOLOGY
CEDAR RIVER HARBOR, MICHIGAN

1. INTRODUCTION

The soils and geological information were obtained for the proposed channel dredging and breakwater construction at Cedar River Harbor, Michigan. The soils investigation and testing were undertaken to determine the distribution and physical characteristics of the subsurface materials which will be encountered in the dredged area and which will support the rubble mound breakwater.

2. SITE LOCATION

Cedar River Harbor is located at the mouth of the Cedar River on the western shore of Green Bay on Northern Lake Michigan. The town of Cedar River, Michigan occupies the banks of this river at its outlet to Green Bay. The Federal improved deep water harbors of Menominee, Michigan and Sturgeon Bay, Wisconsin are also located on the shores of Green Bay. Menominee Harbor is approximately 27 miles southwest and Sturgeon Bay Harbor is about 46 miles south of the harbor under study. The watershed which Cedar River drains is about 350 sq. miles, and the normal discharge of the river is small. This small discharge is due to the small drainage area and, since the area is sparcely populated with few clear tracts, limited surface runoff.

3. SITE GEOLOGY

The overburden soils at the site consist mainly of glacial drift of the Pleistocene Epoch.

The overburden lake deposits consist of recent alluvium (sandy silts and silty sands), glacial till, (compact sand silts, clayey silts, silty clays or silty sands), lacustrine deposits (clays and silts

of low and high compressibility, organic or inorganic).

The alluvium is transported by streams and shore processes which erode the material from the glacial drift and deliver it to the lake. The lacustrine deposits have accumulated in depressed areas of the former lake bottom topographies. These deposits are primarily silt or clay deposits which are either lenticular or continuous over a specific area. Many of these deposits are organic in nature. The glacial till is the remnant of the four advances and retreats of the glaciers which occurred during the Pleistocene Epoch. Most of this till has a dense consistency. This material consists of a dense heterogeneous mixture of sand, gravel, silt, and clay.

In some areas, the soil types encountered in Lake Michigan tend to be erratic in profile. Therefore, only a detailed foundation exploration can indicate the various geologic deposital units and types of soils found in Cedar River Harbor.

None of the borings were drilled into bedrock for the current project. Underlying the overburden deposits is a bed of Lower Mississippi limestone of moderate thickness. The Lower Magnesian limestone formation rests comformably on the Upper Cambrian Potsdam sandstone. The limestone is dolomitic in character and is interstratified with shale and sandstone lenses.

4. CONSTRUCTION HISTORY

For a detailed description of the construction history, the reader is referred to the main body of this Design Memorandum.

5. FOUNDATION EXPLORATION

The exploration program consisted of 19 borings. For the plan and profile of the borings refer to plates A-2A to 2F. A clarification

of eight of these borings is presented on plates A-2A and A-2b. Three of the 19 borings, CCR 500-502, were made in the river channel at the mouth of the river where it discharges into Green Bay. These borings were made thru the ice (approximately 18" thick) on 24 and 25 January 1962. These borings were made with a Joy truck-mounted drill rig working from a barge. A 370 lb. hammer with a free fall of 1.7 feet was used to advance the drive barrel. All samples were of the disturbed type. The balance of the borings, CCR 503-516, were made between 25 May 1967 and 13 June 1967. The same drill machine and a similar barge operation as employed in 1962 was utilized. The same hammer weight having a 1.8 foot drop was used during this operation. Three undisturbed cohesive soil samples were taken using a push and a piston sampler. All the remaining samples which were taken were of disturbed type obtained by a 2-1/2", 3" or 5" drive barrel. Due to the dense nature of the material below approximately - 15 below L.W.D., in some instances, it was found that in order to avoid refusal it was deemed necessary to switch from a 5" drive barrel to a 3" drive barrel in order to advance the hole.

The maximum depth of any boring is 35 feet (CCR-506). None of the borings were drilled into bedrock.

6. DESCRIPTION OF MATERIALS

The material in the river channel bed is recent alluvium, and consists of relatively unconsolidated, loose, poorly sorted fine sand, slightly silty, (SP-SM, SP) to a depth of approximately 10 feet below the channel bottom. This material contains wood fragments which are probably the remains of paper wastes of sawmill industries located upstream on the Cedar River. It appears that a filter course is, therefore, needed to meet the D_{15}/D_{85} ratio. The bedding layer is 100 to 1000 lb. stone whereas the subgrade is principally a sand or sandy gravel. Underlying this material in the river channel is medium to dense gravelly or silty sand (SM, SM-SC, GM-GC, SM-SP). The denseness of this material as indicated by its high blow count would tend to imply that its origin is probably glacial in nature.

The alluvium appears to become thinner in the vicinity of the edges of the new proposed dredged channel. At the outer end of the river channel, the alluvium is approximately 2-3 feet thick in the vicinity of borings CCR-517 and 505.

Along the present and proposed alignment of the rubble mound breakwater (from borings CCR-506, 503, 507, 514, 508, 504, 509, 515 and 510) soil, to a depth of approximately 10 feet below the lake bottom of a medium to dense silty sand and sand (SP-SM, SP-SM) was predominantly found.

The density of this material generally increased with depth. At depths greater than 10 feet below the lake bottom, dense to very dense (increasing with depth) clayey or silty sand (SM, SM-SC, SC-SM, SC) was encountered. This material is very compact as indicated by the high blow counts obtained during drilling operations. The foundation materials along the alignment of the breakwater are probably semi-consolidated alluvium (upper 10 feet or less in places) which gradually change with depth into consolidated glacial till to ice contact material. It was also found that thin strata of organic silt (OL and OH) were encountered (Boring CCR-503, 513). It is indicated from the borings that these are most probably isolated pockets or lenses of these materials.

7. LABORATORY SOILS TESTING

All soils samples were visually classified according to the Unified Soils Classification at the NCD Laboratory. Seventeen combined mechanical analyses were made (refer to plates A-3 thru A-13). Three unconfined compression tests were performed on the undisturbed samples (plates A-14 to A-16). Six "Q" shear tests were performed on remodeled materials at low (3) and high (3) densities, respectively. Two remolded "S" shear tests were made at a high and at a low density, respectively, (plates A-17 to A-24). All other laboratory test results may be found on the soil boring profiles (plates 2A to 2F and the Test Data Summary Sheets, plates A-25 to A-28).

8. STABILITY ANALYSIS OF RUBBLE MOUND BREAKWATER

The following are the adopted design values for the breakwater which were used in the stability analyses.

Capstone	SAT = 120 pcf Submerged = 60 pcf $\phi = 42^{\circ}$ C = 0
Core & Bedding Stone	Submerged = 60 pcf $\phi = 42^{\circ}$ C = 0

Two idealized soil profiles were utilized. Both profiles have the typical breakwater section A (refer to sheet No. 1, Main Text) placed on them. This breakwater section gives the maximum loading condition.

a. Case I

The idealized soil profile which, most probably, typically represents the soil along the proposed breakwater alignment is as follows:

Depth or Thickness 10 feet	Medium to Dense Silty Sand (SP-SM) Submerged = 60 pcf $\phi = 30^{\circ}$ C = 200 psf
Depth greater than 10 feet	Dense Clayey or Silty Sand (SM to SM-SC) Submerged = 76 pcf C = 360 psf $\phi = 25^{\circ}$

Using the circular arc method of analysis with the above values, the minimum factor of safety obtained was 1.7 (see plate A-29).

b. Case II

There is a possibility that a continuous layer of the previously mentioned organic silt may be present in the foundation along the proposed breakwater alignment. Using the minimum depth (implies minimum passive resistance) or organic material (OH) encountered in all of the borings (CCR-513) and superimposing this assumed continuous layer on the previously stated idealized soil profile, the block and wedge analysis was then made using the following values for the organic material.

Thickness	Organic Sandy Silt (OH)
2 feet	Submerged = 28 pcf
	$\phi = 0^{\circ}$
	C = 80 psf

The minimum factor of safety for this case was found to be 1.8 using the block and wedge analysis (see plate A-30). Using the circular arc analysis with the thin organic layer profile, a factor of safety of 1.85 was obtained.

From the stability analyses, the stability of the rubble mound breakwater is found to be adequate.

9. SETTLEMENT ANALYSIS OF BREAKWATER

The settlement of the breakwater in the reach of the maximum section is estimated as approximately 4 inches (see plates A-31 to A-36). It is probable that only the upper 10 feet of the foundation will settle since the soil at lower depths is very compact and under the proposed light loading its settlement will be negligible. The thickness of the bedding stone should be adjusted to compensate for the above mentioned settlement.

The time rate of settlement should be fairly rapid due to the granular nature of the foundation material. A substantial amount should occur during construction and immediately after the end of construction.

10. CONSTRUCTION MATERIALS

a. General

It is considered that under normal conditions (without man-made or natural disasters) adequate construction materials to accomplish the described work are available within reasonable proximity of the jobsite. The quality of all these materials will be subject to approval by the Contracting Officer.

Construction materials required for the proposed project are portland cement, breakwater cover stone and core stone fill, and concrete aggregates.

No sources of concrete aggregate were tested in connection with this Design Memorandum. Materials used for concrete shall comply to EM 1110-2-2000, "Standard Practice for Concrete." Satisfactory sources for this material are listed in Technical Memorandum 6-370, Volume 2 dated September 1953 and current supplements, and may be utilized with the approval of the Contracting Officer.

b. Portland Cement

A low alkali cement should be indicated as a requirement for use in PCC. The following firms producing Portland cement could supply the Cedar River, Michigan area.

Company		Plant Location
(1) Universal Atlas Cement Co. Chicago, Illinois	-	Buffington, Indiana
(2) Petoskey Cement Co. (Penn-Dixie)	-	Petoskey, Michigan

(3) Marquette Cement Co. - Milwaukee, Wisconsin

(4) Lehigh Portland Cement Co. - Oglesby, Illinois

(5) Alpha Portland Cement Co. - LaSalle, Illinois

(6) Medusa Portland Cement Co. - Dixon, Illinois

c. Course Aggregate

Source	Location
Drummond Dolomite, Inc.	Drummond Island, Michigan
Franklin Stone Products Company Limestone Quarry	Franklin, Wisconsin
Halquist - Lannon Stone Company Limestone Quarry	Sussex, Wisconsin
Inland Lime & Stone Company Limestone Quarry	Manistique, Michigan
Milwaukee Limestone Products Co. Limestone Quarry	Milwaukee, Michigan

d. Breakwater Stone

Breakwater stone should be fracture free, adequately sized, and is expected to have a specific gravity of 2.60, based on available sources within a reasonable distance from the project. Stone contained in the existing piers may be removed and used in the proposed structures if the specific gravity, gradation, and quality meet specification requirements of new stone, specific gravity of which should be in the range 2.47 to 2.73 (average 2.60 ± 5%).

(1) Carl Frust Company--Bedford, Indiana
(2) B. G. Hoadley Quarries, Inc.--Bloomington, Indiana
(3) Bloomington Limestone Corp.--Bloomington, Indiana
(4) Independent Limestone Company--Bloomington, Indiana
(5) Indiana Limestone Corp.--Bedford, Indiana
(6) Ingalls Stone Company--Bedford, Indiana
(7) Inland Lime & Stone Quarry--Manistique, Michigan
(8) Valdus Quarry, Middle Level --Valdus, Wisconsin

It is probable that a further source of core and bedding stone for the breakwater may be obtained from the coarse aggregate locations previously listed.

In design of breakwater coverstone, use of dolosse in lieu of rubble-mound was considered. Based upon hydraulic computations, required stone sizes for the breakwater are in the range 0.5 to 6 tons for a two layer pell mell placement with corresponding porosity of layers in the range 37 to 40 percent. Thickness of layers would be 2.6 to 4.8 feet.

Dolosse however for an equivalent placement require a two layer thickness of 3.6 to 7.8 feet with concomitant porosity of 63 percent; this relationship would allow core stone considerable less protection than conventional quarrystone.

Availability of dolosse also would pose a logistical problem , whereas quarrystone is readily available.

e. Fine Aggregate

Source	Location
Natural sand from Dousman Pit	Waukesha, Michigan
Natural sand from Wisottu Sand & Gravel Company	Colgate, Wisconsin

Natural sand from Murphy Construction Company	Kaukauna, Wisconsin
Natural sand from Courtney and Plummer, Inc.	Greenville, Wisconsin

f. Steel Piling

Company	Plant Location
United States Steel Company	Chicago, Illinois
Jones & Laughlin Steel Company	Hammond, Indiana
Bethlehem Steel Company	Chicago, Illinois
Inland Steel Company	Chicago, Illinois

11. CHANNEL DREDGING SIDE SLOPES

The dredging side slopes of the channel may be taken as 3 horizontal on 1 vertical since the effective angle of internal friction at the sides of the river channel may be taken at 2/3 ϕ or 20^{o} for the medium to dense silty sand. Use of a flatter slope will be considered during preparation of plans and specifications.

12. CONCLUSIONS

The foundation exploration, soil testing and design analysis indicate no great difficulties are anticipated during construction of the proposed rubblemound breakwater and channel dredging.

Construction materials are available for the proposed project by water, rail and truck transportation.

RECREATIONAL BOAT HARBOR
CEDAR RIVER, MICHIGAN

SUPPLEMENT NO: 1
REVISION TO GENERAL DESIGN MEMORANDUM NO: 1
STONE SIZE COMPUTATIONS

1. DESIGN OF RUBBLE MOUND PIER

a. Cover Stone

$$W_H = \frac{Wr\ H^3}{K_D\ (S_r-1)^3\ \text{Cot}\ \theta}$$

(S.P.M. EQ 7-110)

WH = Required Weight of Cover Stone
Wr = 154 #/CF (2.6 x .95 x 62.4 #/CF = 154 #/CF
Ref. Comment 2 x Pg 4 of NCD Comments)
H = 9.5'
KD = 3.5 (Trunk Breaking, Rough Ang, Random, 2
Layers S.P.M. Table 7-7, Pg 7-182)
Sr = 2.47
Cot θ = 2.0

$$W_H = \frac{154 \times (9.5)^3}{3.5\ (2.47-1)^3 \times 2.0} = 5{,}938^{\#} > 1000^{\#}$$

Use $W_{MIN} = 0.75\ W_H$

$W_{MAX} = 1.50\ W_H$

$W_{MIN} = 0.75 \times 5{,}938 = 4{,}446^{\#} \sim 2.22$ T Say 2 1/4 Ton

$W_{MAX} = 1.50 \times 5{,}938 = 8{,}892^{\#} \sim 4.45$ T Say 4 1/2 Ton

Use 2 1/4 To 4 1/2 Ton Stone

b. UNDERLAYER STONE

W = WH/10

W = Required Weight of Underlayer Stone

$W = 5{,}938/10 = 594^{\#} < 1000^{\#}$

Use $W_{MIN} = 0.7W$

$W_{MAX} = 2.1W$

$W_{MIN} = 0.7 \times 594 = 416^{\#}$ Say $425^{\#}$

$W_{MAX} = 2.1 \times 594 = 1247^{\#}$ Say $1250^{\#}$ (See 2B)

Use $425^{\#}$ - $1250^{\#}$ Stone

c. Thickness of Cover Stone and Underlayer Stone

$r = n\ k_D (W/wr)^{1/3}$ (S.P.M Q. 7-113)

r = Required average layer thickness
n = Number of quarry stone in thickness = 2
W = Weight of individual armor stone = W_H
Wr = Unit weight in lbs/cf = 154
K_D = Layer coeff. = 1.15 (S.P.M TABLE 7-11)

$r_{cover} = 2 \times 1.15 \left(\frac{5,938}{154}\right)^{1/3} = 7.77'$ say 7'-9"

Check:

From "Riprap Gradation Curves"

r_{WMIN} = r4500 = 41"

r_{MAX} = r9000 = 50"

Total = 91" = 7'-7" < 7"-9" Provided

$r_{Underlayer} = 2 \times 1.15 \left(\frac{594}{154}\right)^{1/3} = 3.60'$ Say 3'-7"

Check:

From "Riprap Gradation Curves"

r_{WMIN} = r425 = 18"

r_{MAX} = r1250 = 26"

Total = 44" = 3'-8" Use 3'-8"

d. Crest Width

$B = n\ K_D\ (WH/Wr)^{1/3}$ n = 3 MIN

$B = 3 \times 1.15 \left(\frac{5,938}{154}\right)^{1/3} = 11.66'$ For n = 2, B = 7.77"

2. DESIGN OF PIER HEAD — Use B = 8' For Inspection & Handicapped People

a. Cover Stone

(i) Slope 2.0:1

$$W_H = \frac{Wr(H)^3}{K_D\,(S_r-1)^3\,\text{Cot}\,\theta}$$

Wr = 154 #/CF
H = 9.5'
KD = 2.9 (Head, Breaking, Rough, Round, & 2 Layers)
Sr = 2.47
Cot θ = 2.0

$$W_H = \frac{154 \times (9.5)^3}{2.9\,(2.47-1)^3 \times 2.0} = 7{,}167^{\#} > 1000^{\#}$$

Use $W_{MIN} = 0.75\ W_H$

$W_{MAX} = 1.5\ W_H$

$W_{MIN} = 0.75 \times 7{,}167 = 5{,}375^{\#} \sim 2.7$ Ton Say 2 3/4 Tons

$W_{MAX} = 1.50 \times 7{,}167 = 10{,}750 \sim 5.4$ Ton Say 5 1/2 Tons

2 3/4 to 5 1/2 Ton Stone

(ii) Slope 2:1

KD = 2.5
Cot θ = 2

$$W_H = \frac{154 \times (9.5)^3}{2.5\,(2.47-1)^3 \times 2} = 8{,}313^{\#} > 1000^{\#}$$

$W_{MIN} = 0.75 \times 8{,}313 = 6{,}235^{\#}$ 3.11 T Say 3 1/4 Ton

$W_{MAX} = 1.50 \times 8{,}313 = 12{,}470$ 6.23 T Say 6 1/4 Ton

Use 3 1/4 to 6 1/4 Ton Stone

b. UNDERLAYER STONE

$W = WH/10 = 8,313/10 = 831^{\#} < 1000^{\#}$

Use $W_{MIN} = 0.7W$

$W_{MAX} = 2.1W$

$W_{MIN} = 0.7 \times 831 = 582^{\#}$ Say $600^{\#}$

$W_{MAX} = 2.1 \times 831 = 1745^{\#}$ Say $1750^{\#}$

c. THICKNESS OF COVER STONE & UNDERLAYER STONE

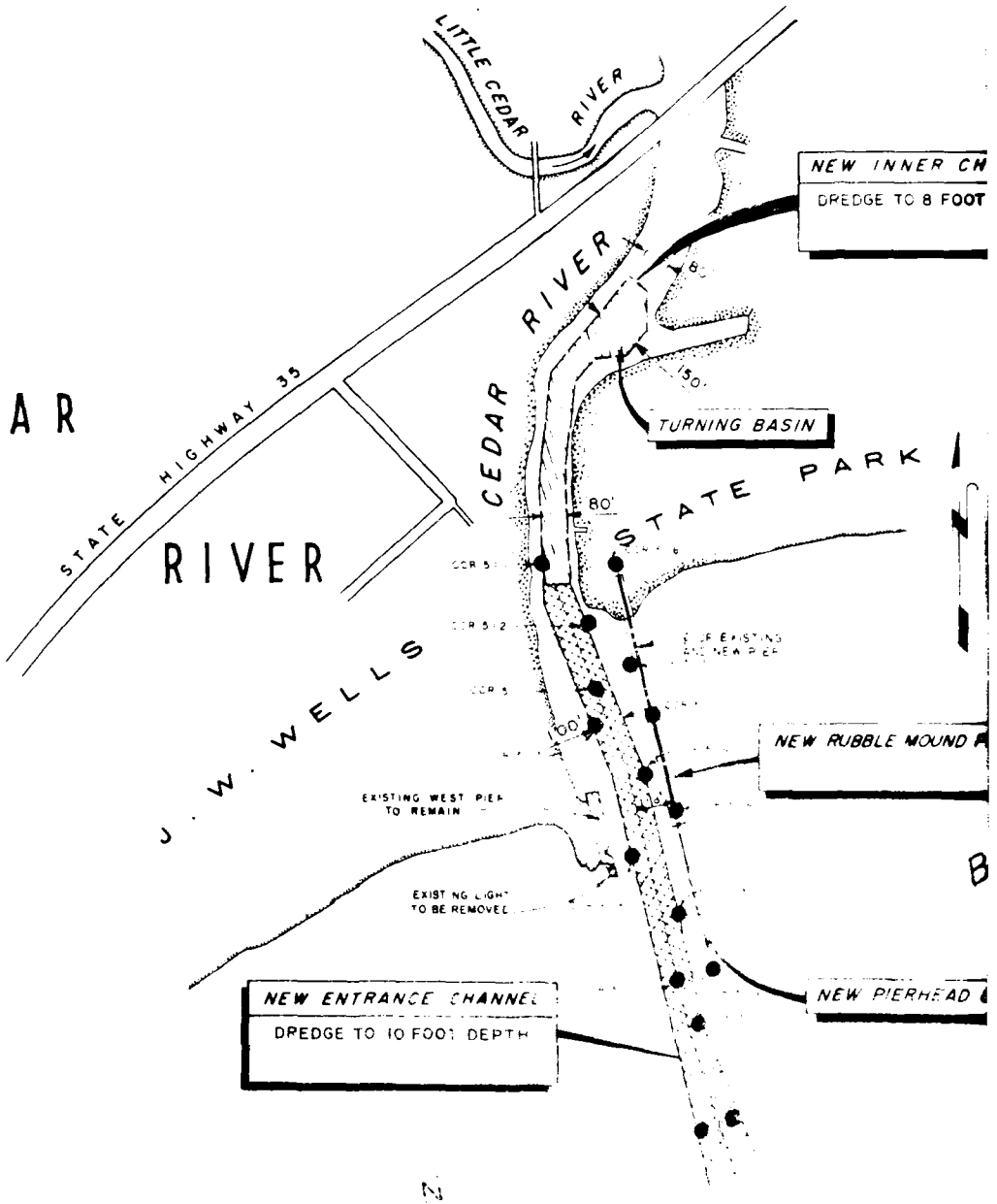
r_{Cover} = 7"-9" (See 1c for Comps)

$r_{Underlayer}$ = 3'-8" (See 1c for Comps)

SUMMARY

Rubble Mound Pier (Trunk)	Cover Stone	2 1/4 to 4 1/2 Ton, 7'-9" Thick
	Underlayer Stone	$425^{\#}$-$1250^{\#}$, 3"-8" Thick
	Slope	1 on 2.0
	Crest Width	8'
	Bedding Stone	$1^{\#}$-$70^{\#}$ 1'-0" Thick
Pier Head	Cover Stone	3 1/4 to 6 1/4 Ton, 7'-9" Thick
	Underlayer Stone	$600^{\#}$-$1750^{\#}$, 3"-8" Thick
	Slope	1 on 2 Wrap around
	Crest Width	8'-0"
	Bedding Stone	$1^{\#}$-$70^{\#}$ 1'-0" Thick

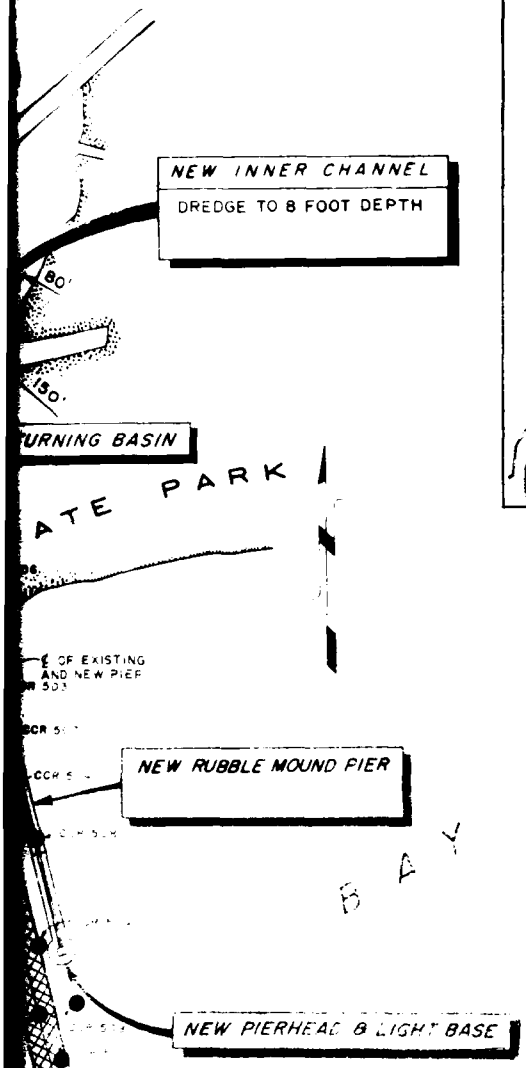
CORPS OF ENGINEERS

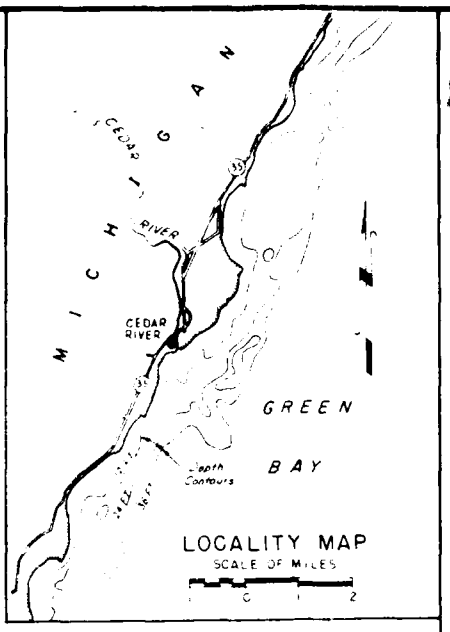


PLAN

SCALE IN FEET

U.S. ARMY





DESCRIPTION BY

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
DETROIT, MICHIGAN

CHECKED BY

DRAWN BY

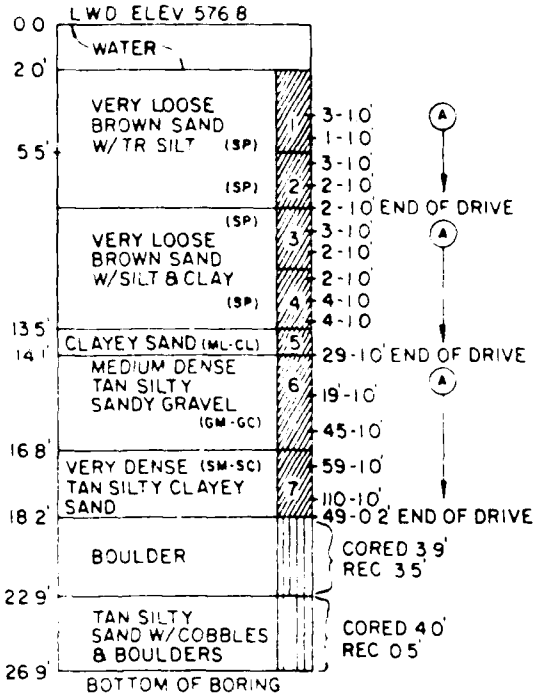
TRACED BY

CEDAR RIVER HARBOR
CEDAR RIVER, MICHIGAN
RUBBLE MOUND PIER AND CHANNEL

BORING LOCATION PLAN

1 / 2

BORING NO. CCR-500-62
24 JAN. 1962



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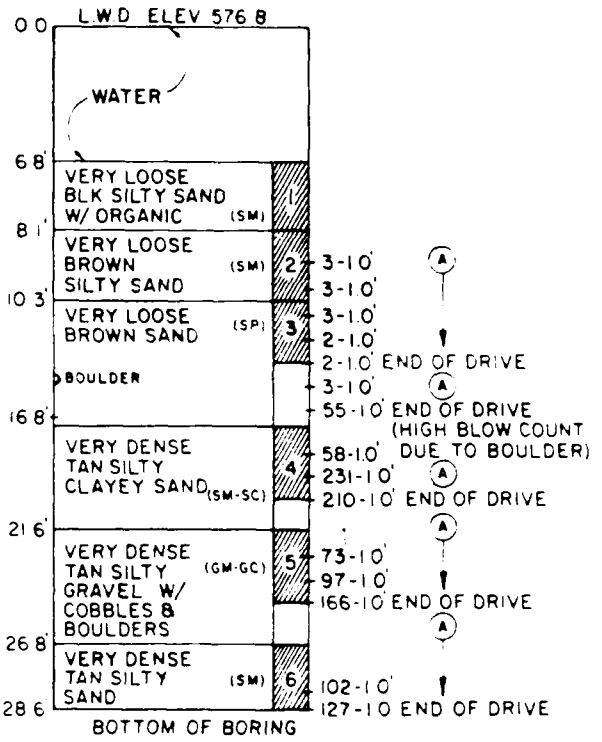
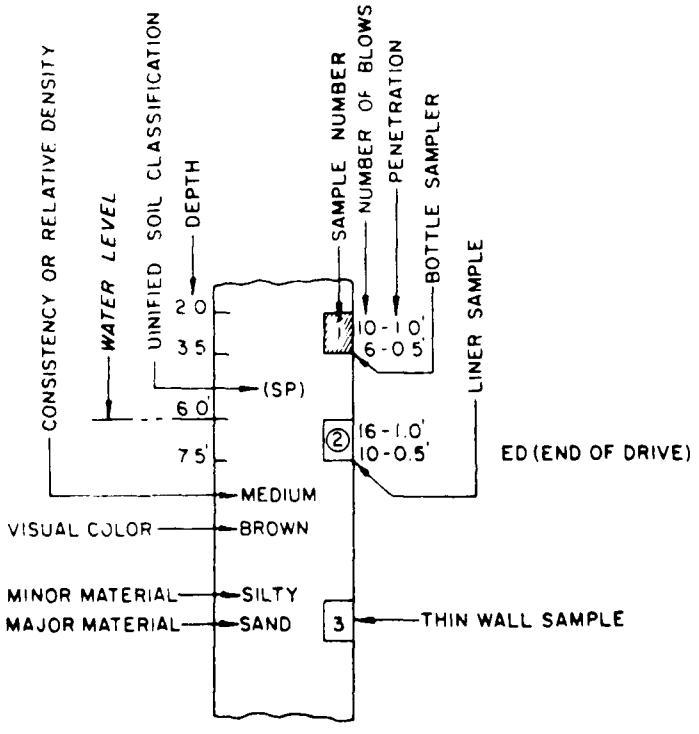
25 JAN. 1962

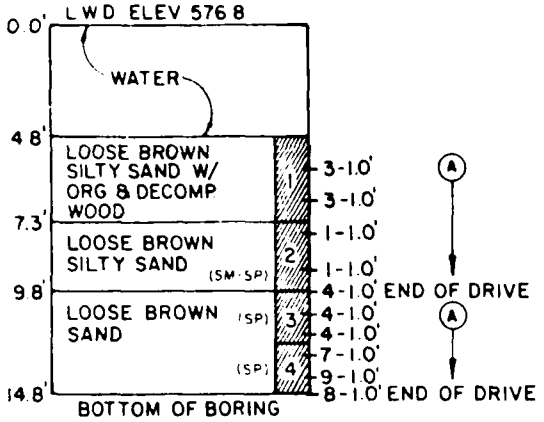




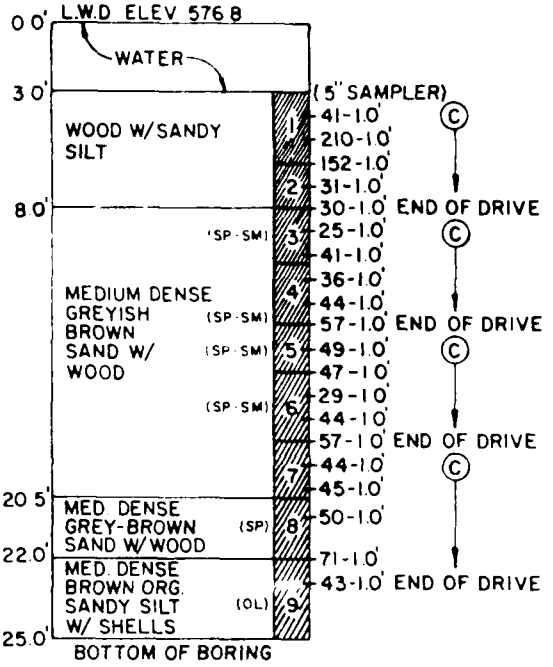
BORING LOG LEGEND

PLATE A-2A

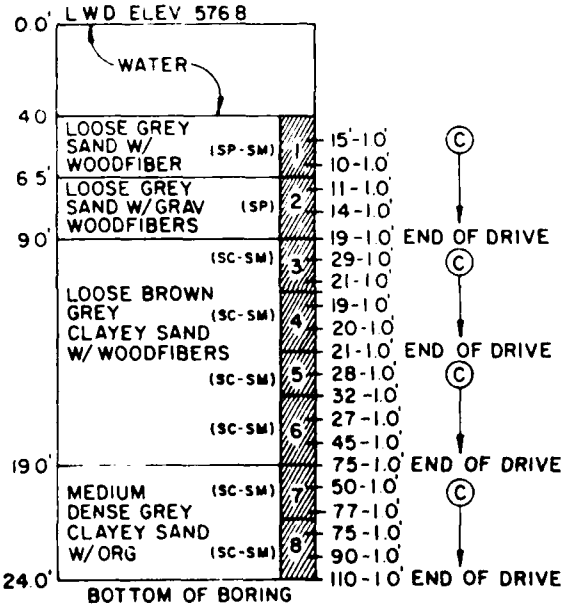
BORING NO. CCR-502-62
26 JAN. 1962



BORING NO. CCR-503-67
8 JUNE 1967



BORING NO. CCR-504-67
7 JUNE 1967



BORING NO. CCR-505-67
9 JUNE 1967

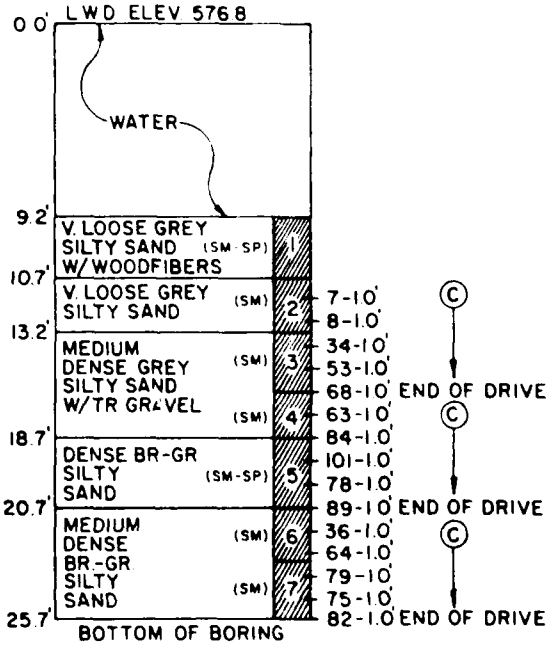
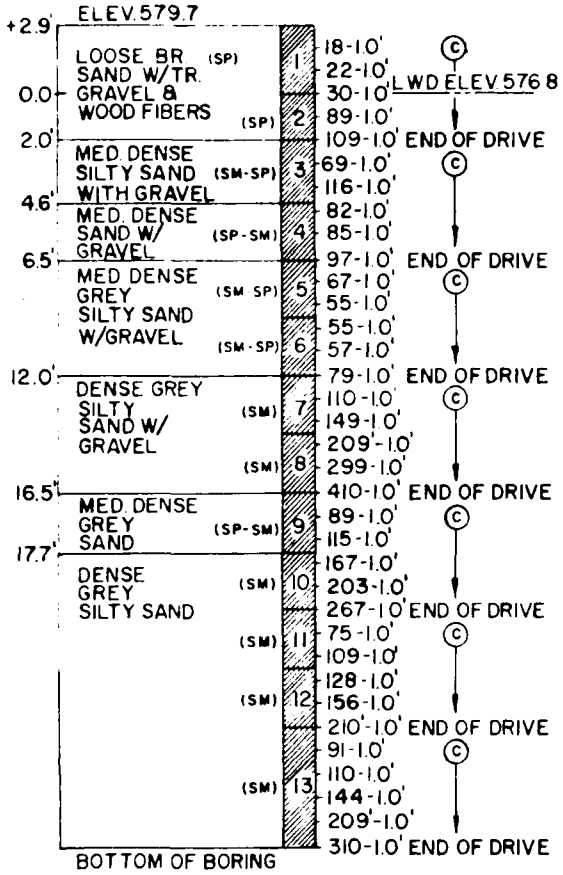
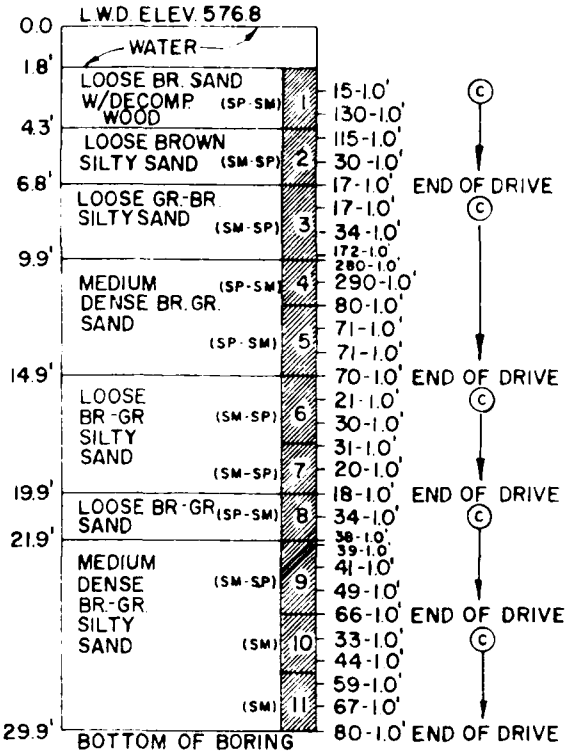


PLATE A-28

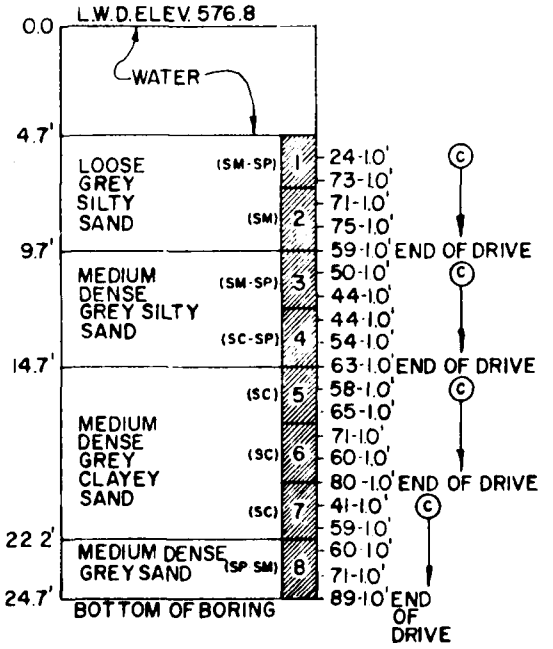
BORING NO. CCR 506-67
13 JUNE 1967



BORING NO. CCR 507-67
12 JUNE 1967



BORING NO. CCR 508-67
9 JUNE 1967



BORING NO. CCR 509-67
10 JUNE 1967

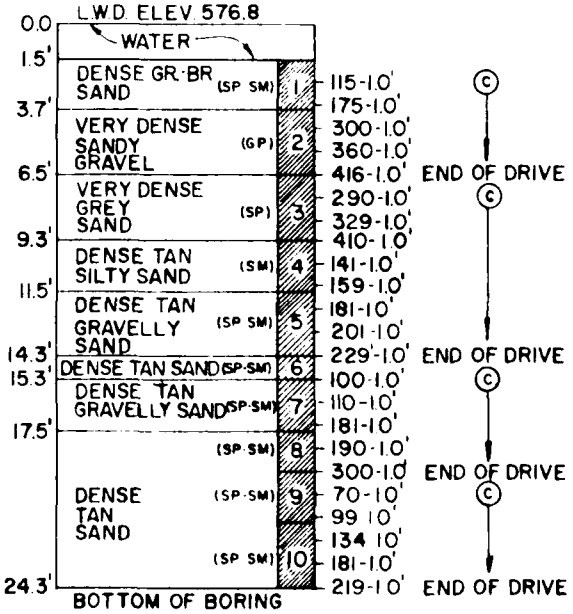


PLATE A-2C

RELATIVE DENSITY OF SAND & SILT

	140# HAMMER FALLING 30" ①				370# HAMMER FALLING 1.8' ①				
	1-1/2" I.D. or 2" O.D. ○ ②	2" I.D. or 2 1/2" O.D. ○	2-1/2" I.D. or 3" O.D. ○	3" I.D. or 3-1/2" O.D. ○	1-1/2" I.D. or 2" O.D. ○	2" I.D. or 2-1/2" O.D. ○	2-1/2" I.D. or 3" O.D. Ⓐ	3" I.D. or 3-1/2" O.D. Ⓑ	5" I.D. or 5-1/2" O.D. Ⓒ
VERY LOOSE	<4	<5	<6	<8	<2	<3	<3	<4	<12
LOOSE	4-10	5-13	6-16	8-20	2-5	3-7	3-8	4-11	12-32
MEDIUM	10-30	13-39	16-48	20-60	5-15	7-21	8-25	11-32	32-96
DENSE	30-50	39-65	48-81	60-100	15-25	21-34	25-43	32-53	96-162
VERY DENSE	>50	>65	>81	>100	>25	>34	>43	>53	>162

CONSISTENCY OF CLAY

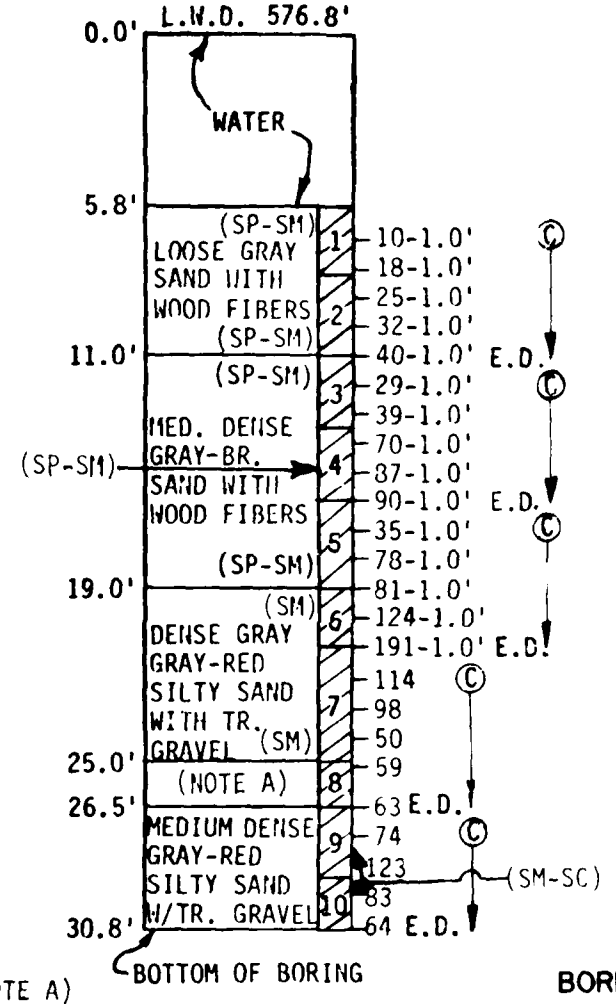
	140# HAMMER FALLING 30" ①				370# HAMMER FALLING 1.8' ①					Q (TSF) ULT
	1-1/2" I.D. or 2" O.D. ○ ②	2" I.D. or 2-1/2" O.D. ○	2-1/2" I.D. or 3" O.D. ○	3" I.D. or 3-1/2" O.D. ○	1-1/2" I.D. or 2" O.D. ○	2" I.D. or 2-1/2" O.D. ○	2-1/2" I.D. or 3" O.D. Ⓐ	3" I.D. or 3-1/2" O.D. Ⓑ	5" I.D. or 5-1/2" O.D. Ⓒ	
VERY SOFT	<2	<3	<3	<4	<1	<2	<2	<2	<3	0.25
SOFT	2-4	3-5	3-6	4-8	1-2	2-3	2-3	2-4	3-6	0.25-0.50
MEDIUM	4-8	5-10	6-13	8-16	2-4	3-5	3-7	4-8	6-13	0.50-1.00
STIFF	8-15	10-19	13-24	16-30	4-8	5-10	7-12	8-15	6-24	1.00-2.00
VERY STIFF	15-30	19-39	24-48	30-60	8-15	10-20	12-24	15-30	24-48	2.00-4.00
HARD	>30	>39	>48	>60	>15	>20	>24	>30	>48	>4.00

① PENETRATION RESISTANCE SHOWN AS # BLOWS/FT.

② STANDARD PENETRATION TEST

BORING NO. CCR510-67

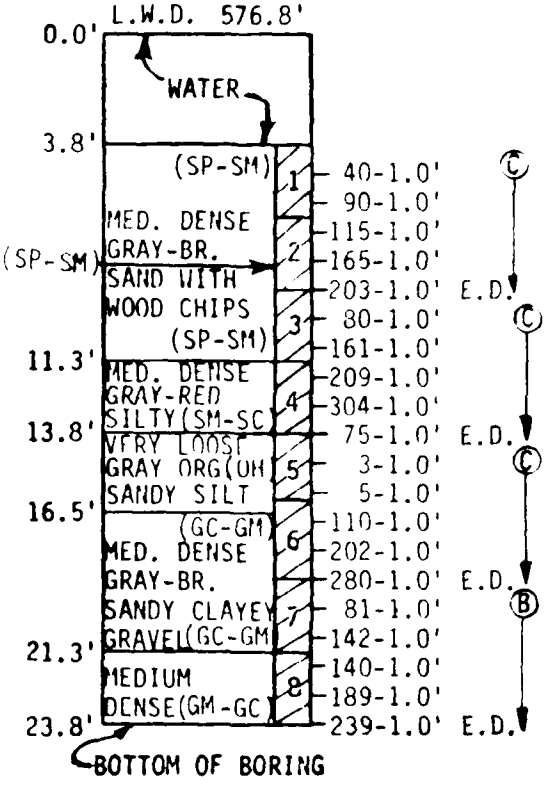
6 JUNE-1967



(NOTE A)
DENSE GR. RD.
CLAYEY SAND
W/TR. GRAV.
(SC)

BORING NO. CCR513-67

29 MAY-1967



BORING NO. CCR511-67

25 MAY-1967

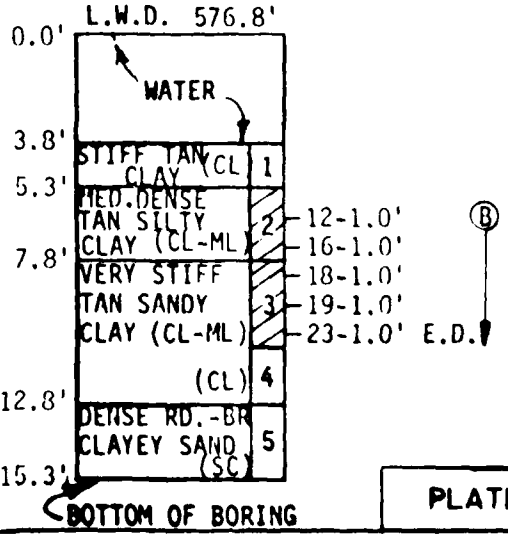
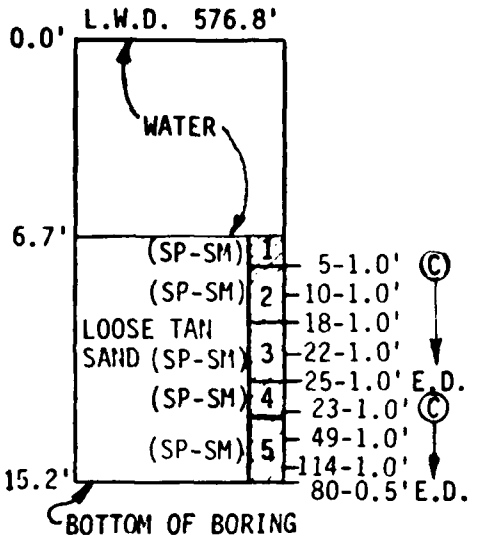


PLATE A-2D,

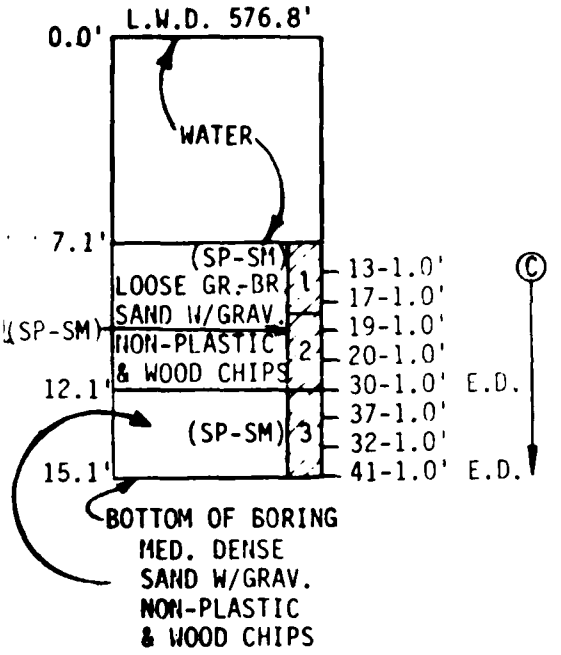
BORING NO CCR 512-67

26 MAY-1967



BORING NO CCR 514-67

8 JUNE-1967



BORING NO CCR 515-67

5 JUNE -1967

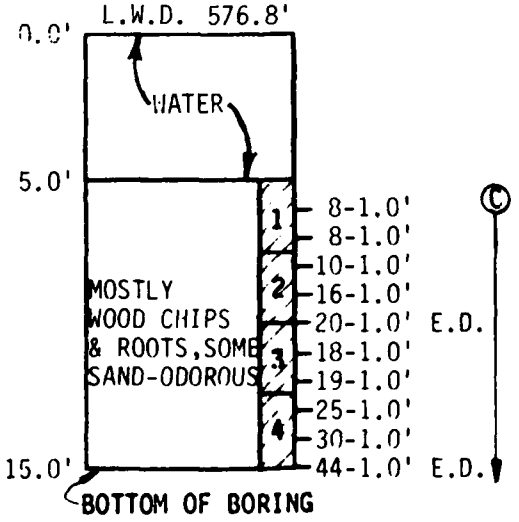
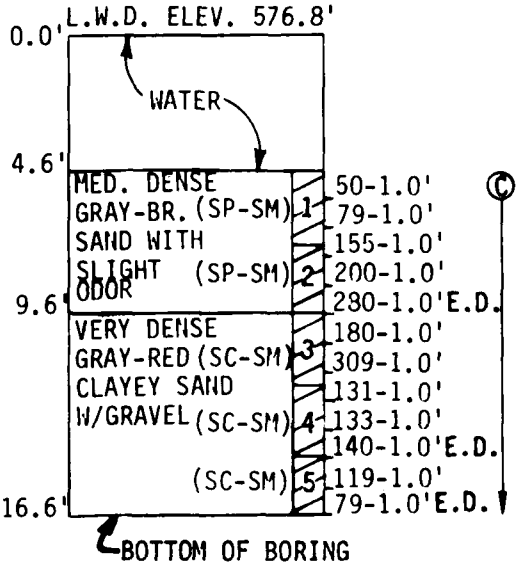
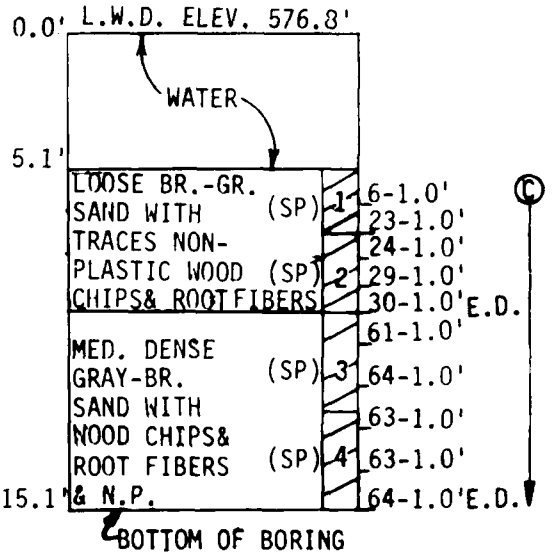


PLATE A-2E

BORING NO CCR 516-67
6 MAY 1967



BORING NO CCR 517-67
9 JUNE 1967



BORING NO CCR 518-67
9 JUNE 1967

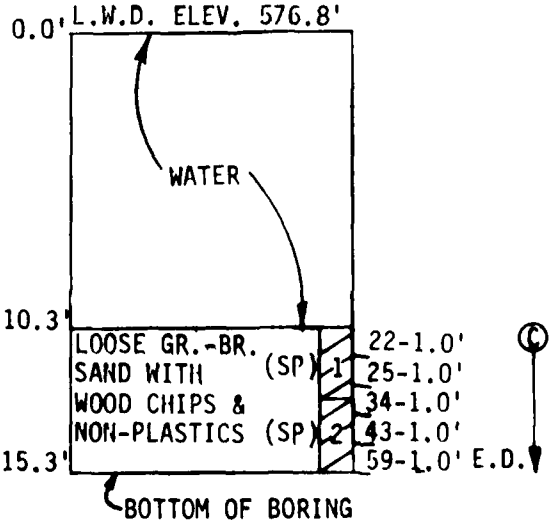
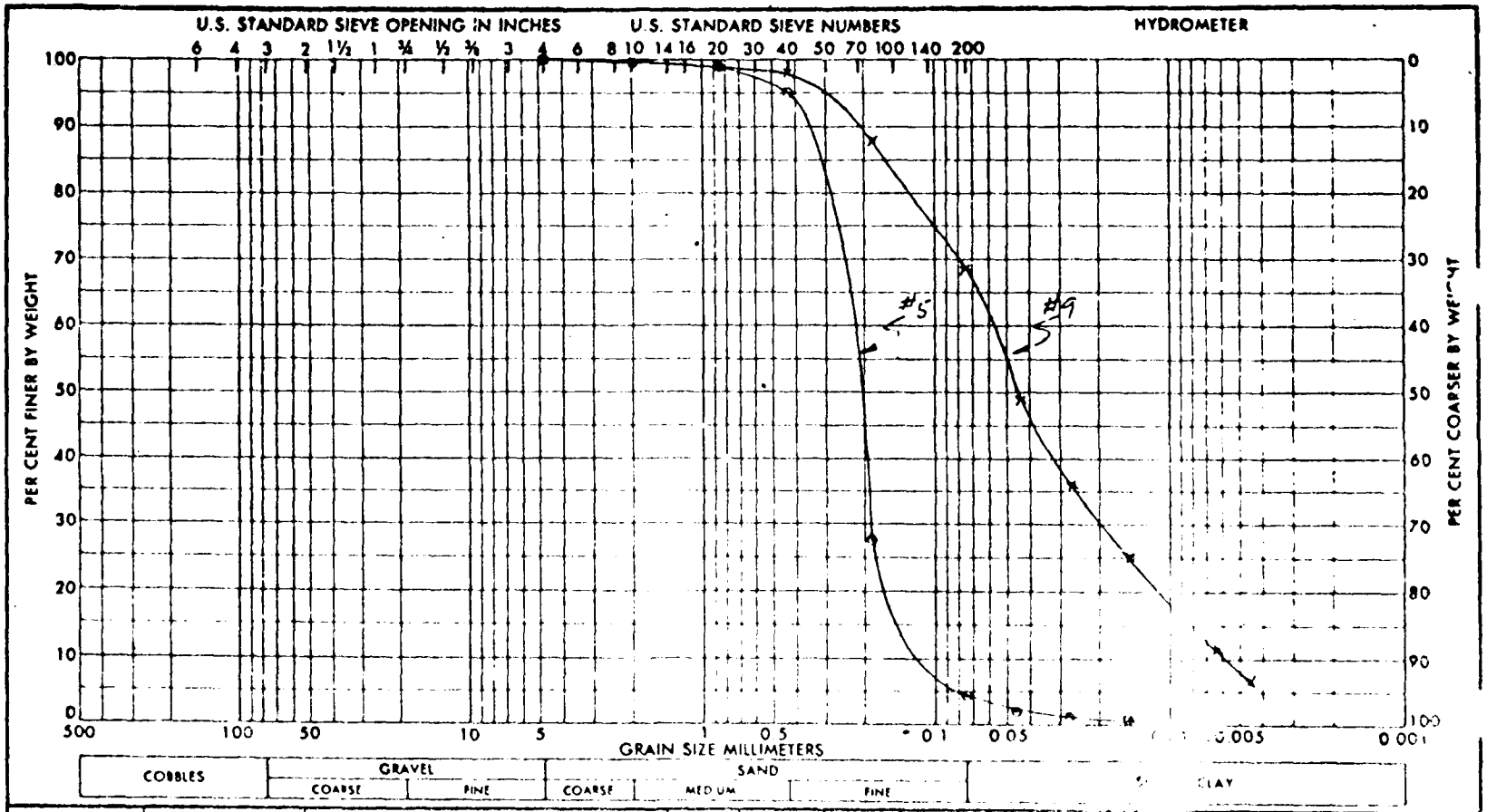


PLATE A-2F



SAMPLE NO	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
S/C-5425	10.0'-12.0'	Sand (SP)		(Visual)		
S/C-5426	19.0'-22.0'	Organic Sandy Silt (OL)		47	30	17

PROJECT: Cedar Harbor, Michigan

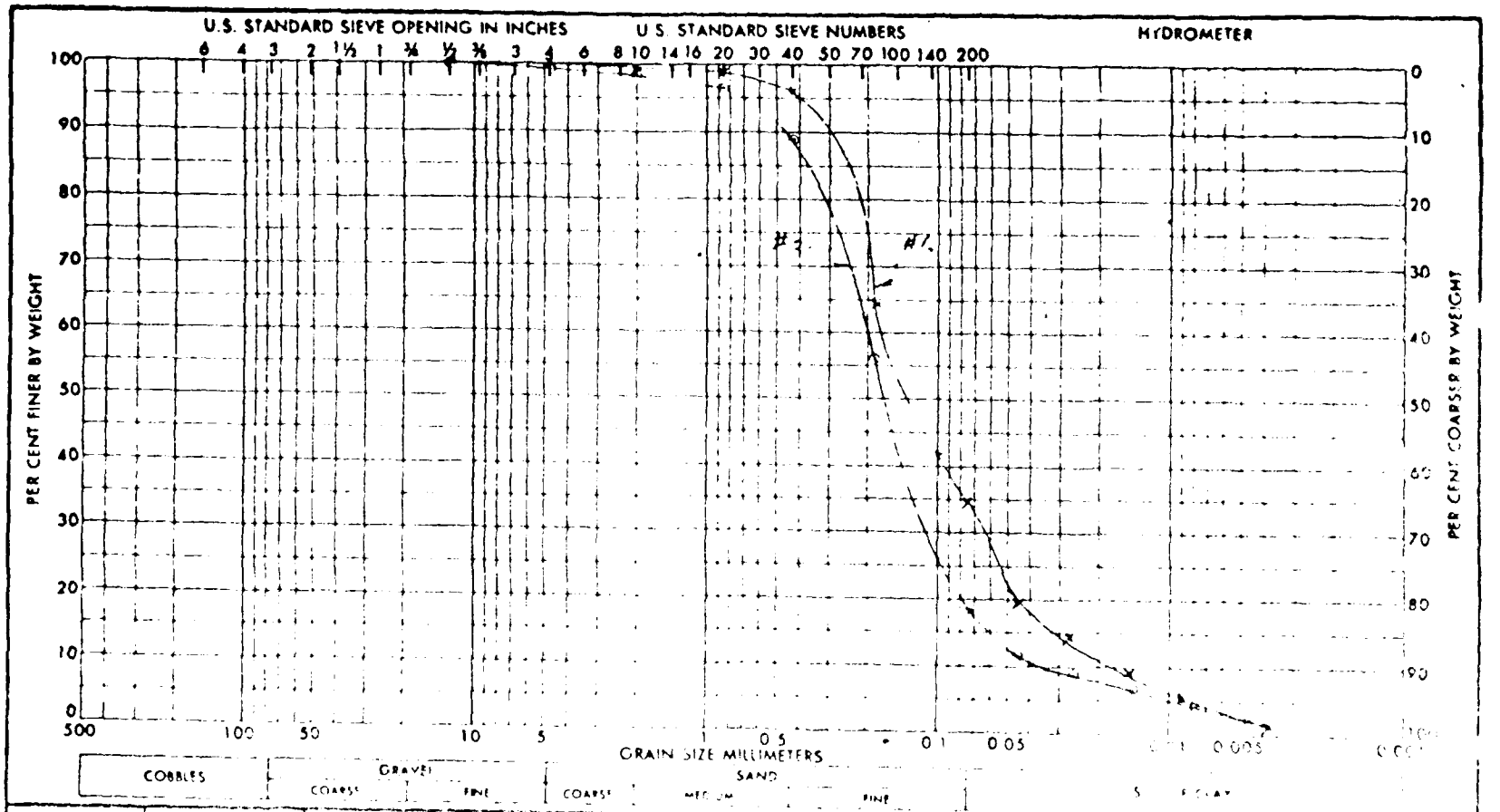
GRADATION CURVES

1967

PLATE 3

ENG FORM 2087
1 MAY 63

REPLACES WES FORM NO. 1241, SEP 1962, WHICH IS OBSOLETE.

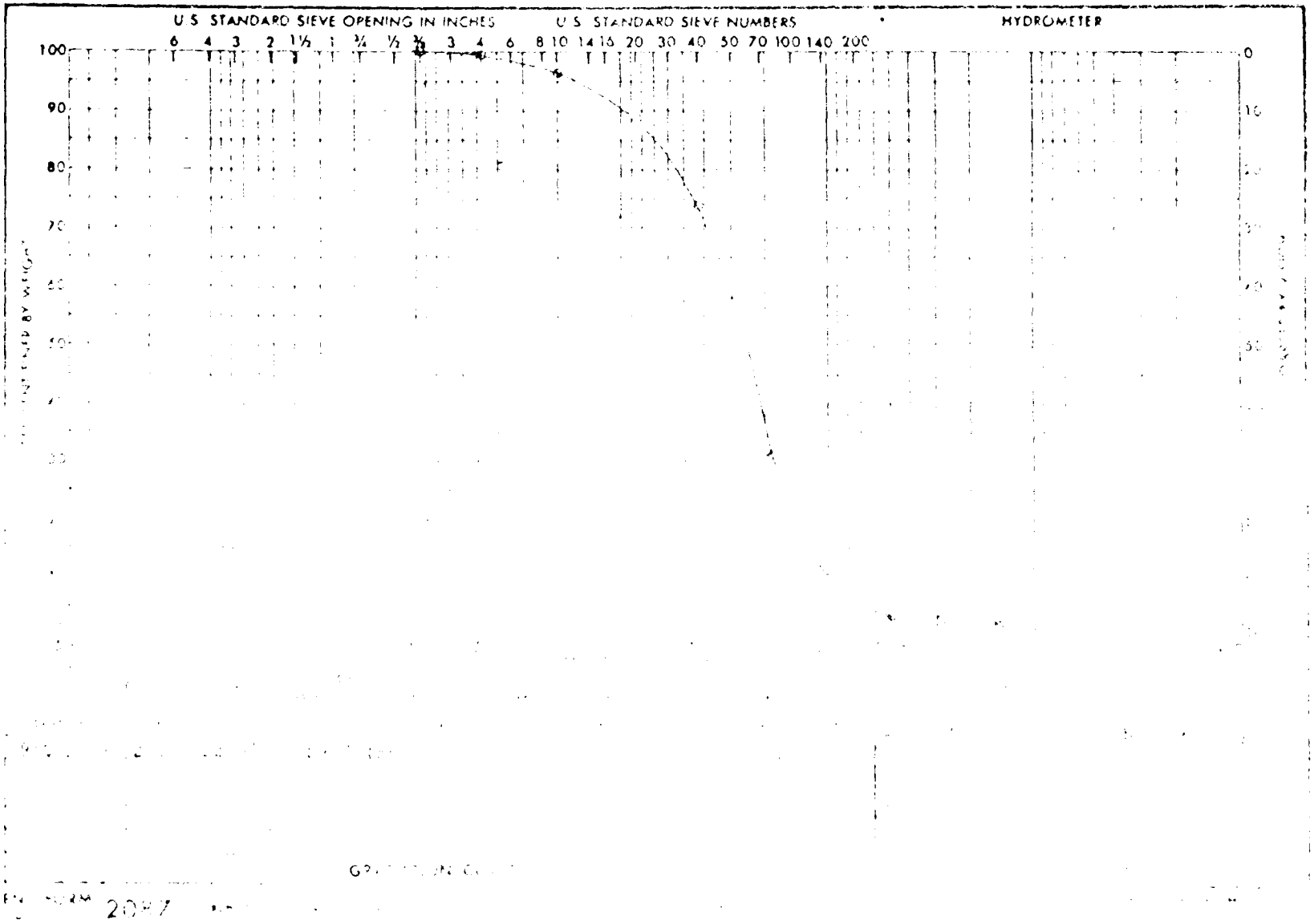


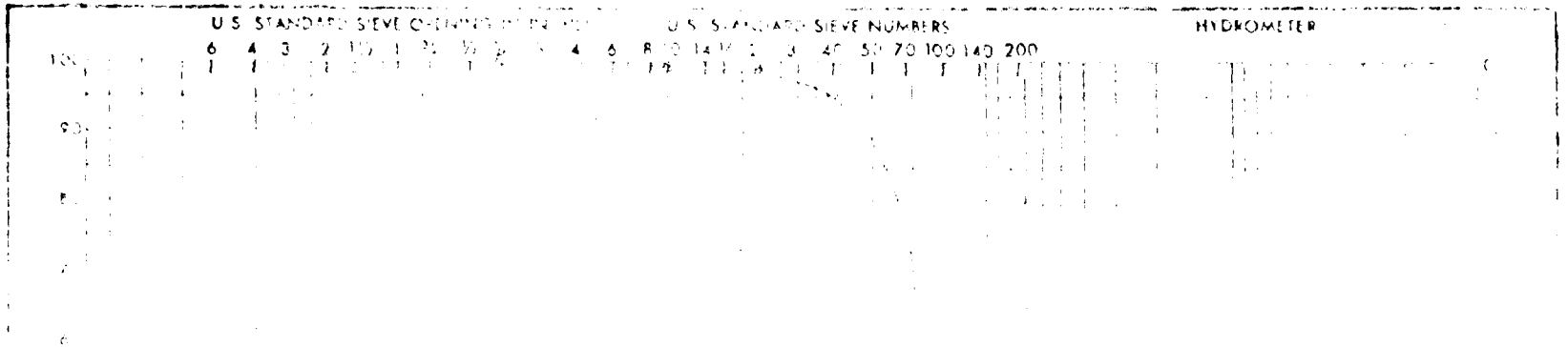
SAMPLE NO.	CLASSIFICATION	NAT. W%	
B/C-5427	5.0'-7.5' Clayey Sand (SC-SM)	(Visual)	
B/C-5428	12.0'-15.0' Clayey Sand (SC-SM)	(Visual)	

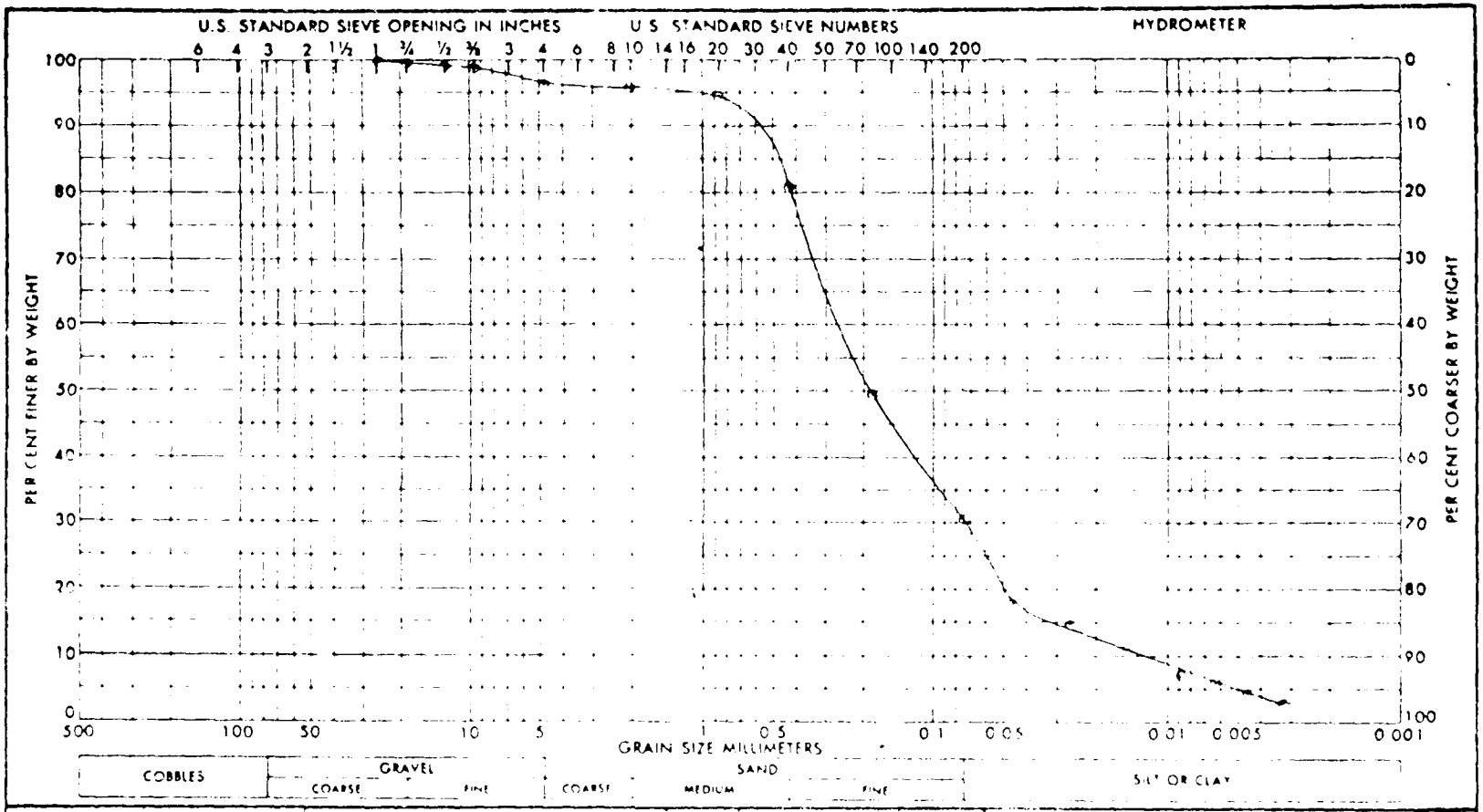
GRADATION CURVES

PLATE 4

ENG FORM 2087


U S STANDARD SIEVE OPENING IN INCHES
U S STANDARD SIEVE NUMBERS
HYDROMETER
6 4 3 2 1½ 1 ¾ ½ ⅜ 3 4 6 8 10 14 16 20 30 40 50 70 100 140 200
100
90
80
0
10


U.S. STANDARD SIEVE OPENINGS IN INCHES
U.S. STANDARD SIEVE NUMBERS
HYDROMETER
6
4
3
2
1½
1
¾
½
⅜
¼
4
6
8
10
14
16
20
30
40
50
70
100
140
200
100
90
80



SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT. W%	LL	PL	PI
6/C-5431	12.5'-15.0'	Clayey Sand (SC)			(Visual)	

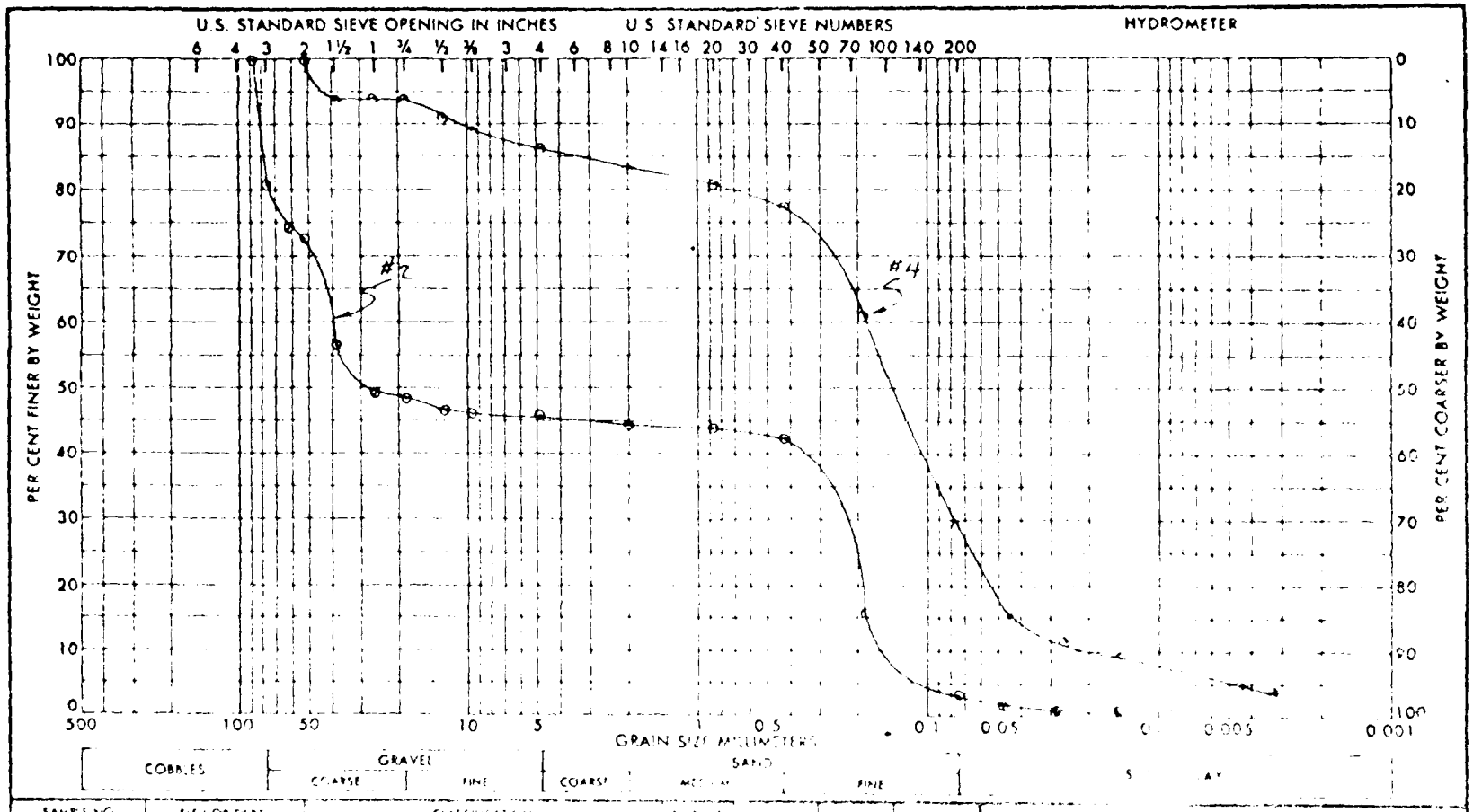
Cedar River Harbor, Michigan

September 1967

PLATE 7

GRADATION CURVES

ENG FORM 2087 REPLACES WES FORM NO. 1241, SEP 1962, WHICH IS OBSOLETE. TRANSLUCENT



SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT. W%	LL	PL	PI
2/C-5432	2.2' - 5.0'	Sandy Gravel (GP)		(Visual)		
4/C-5433	7.8' - 10.0'	Silty Sand (SM)		(Visual)		

GRADATION CURVES

Harbor, Michigan

1967

PLATE 8

ENG FORM 2087

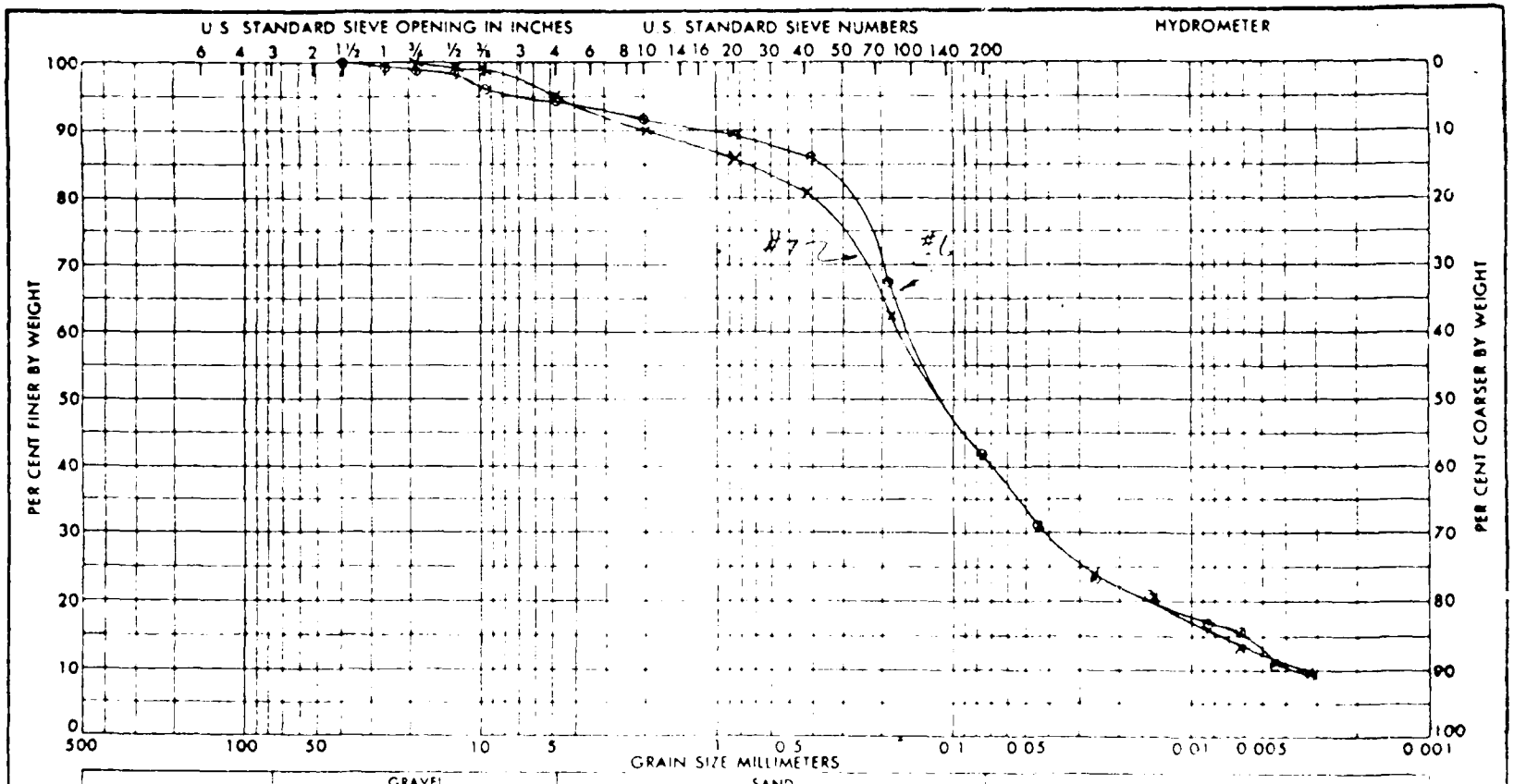


PLATE 9

SAMPLE NO	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	P
6/C-5434	13.0'-15.0'	Silty Sand (SM)	11.3		13	
7/C-5435	15.0'-17.5'	Silty Sand (SM)			(Disqual)	

GRADATION CURVES

PROJECT Cedar River Harbor Michigan

AREA

B.P.N. No.

DATE September 1967

ENG FORM 2087

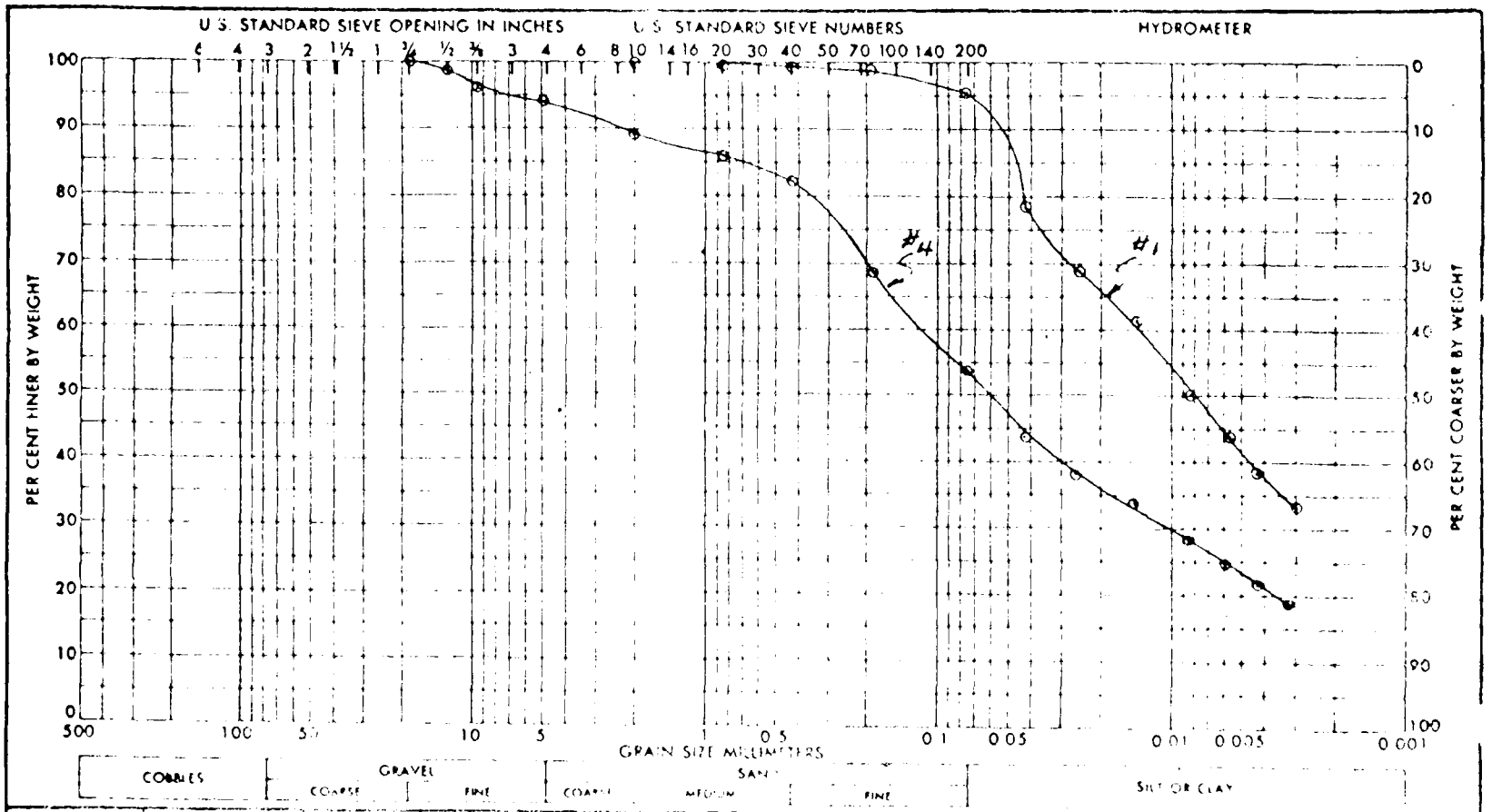


PLATE 10

SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT. W%	LL	PL	PI
1/C-4753	0.0 - 1.5'	Clay (CL)	15.3	25	14	11
4/C-4754	7.0' - 9.0'	Sandy Clay (CL)	12.6	18	11	7

Test specimen taken from [illegible]'-0.88' of 1.80' tube spl.

PROJ. [illegible] Corps of Engineers, Boston, Mass.

AREA [illegible]

BOR. [illegible] C-4753 & 4754

DATE [illegible] Oct 1967

GRADATION CURVES

ENG FORM 2087
1 MAY 63

REPLACES [illegible] FORM NO. 1241, SEP 1962, WHICH IS OBSOLETE.

[illegible] TRANSMITTAL

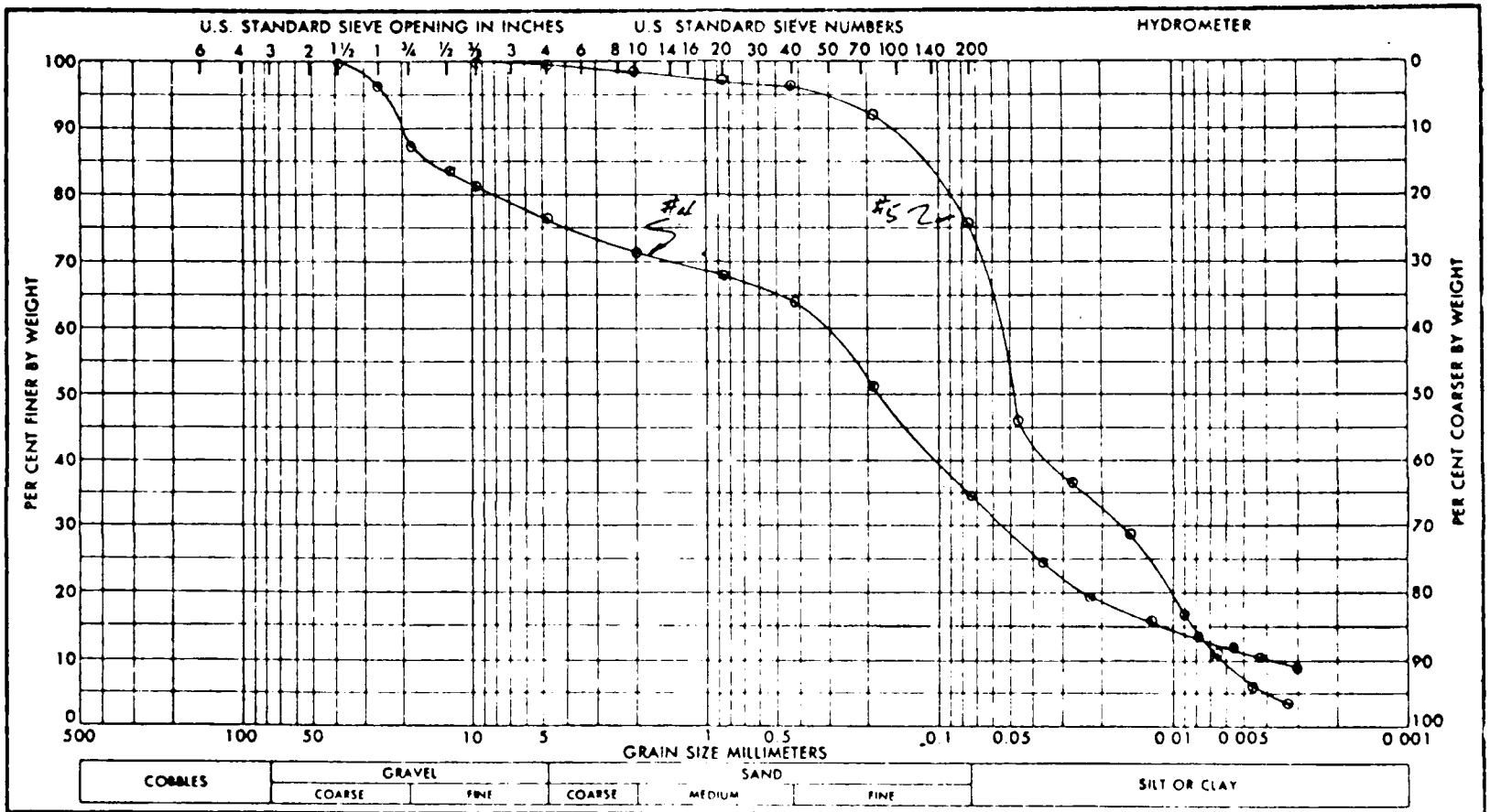


PLATE 11

SAMPLE NO	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
4/C-5436	7.8' - 10.0'	Silty Sand, Gravelly (SM-SC)		(Visual)		
5/C-5437	10.0-12.2'	Organic Sandy Silt (OH)	72.0	76	33	43

GRADATION CURVES

PROJ Cedar River Harbor, Michigan

AREA

BORING NO CCR-513

DATE September 1967

ENG FORM 2087 1 MAY 63 REPLACES WES FORM NO 12a1 SEP 1962 WHICH IS OBSOLETE

TRANSLUCENT

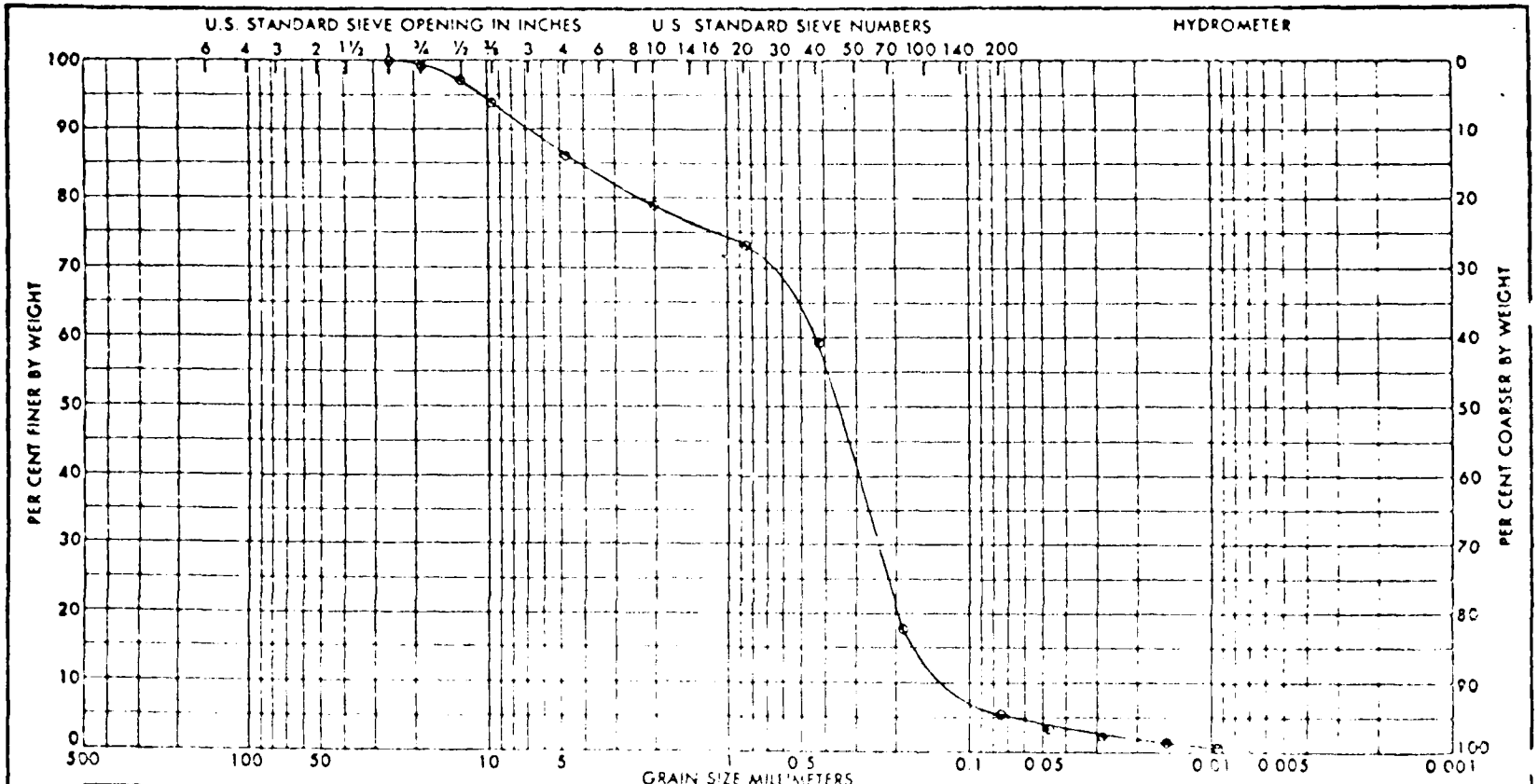


PLATE 12

SAMPLE NO	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
2/C-5438	2.5'-5.0'	Sand (SP-SM)		(Visual)		

GRADATION CURVES

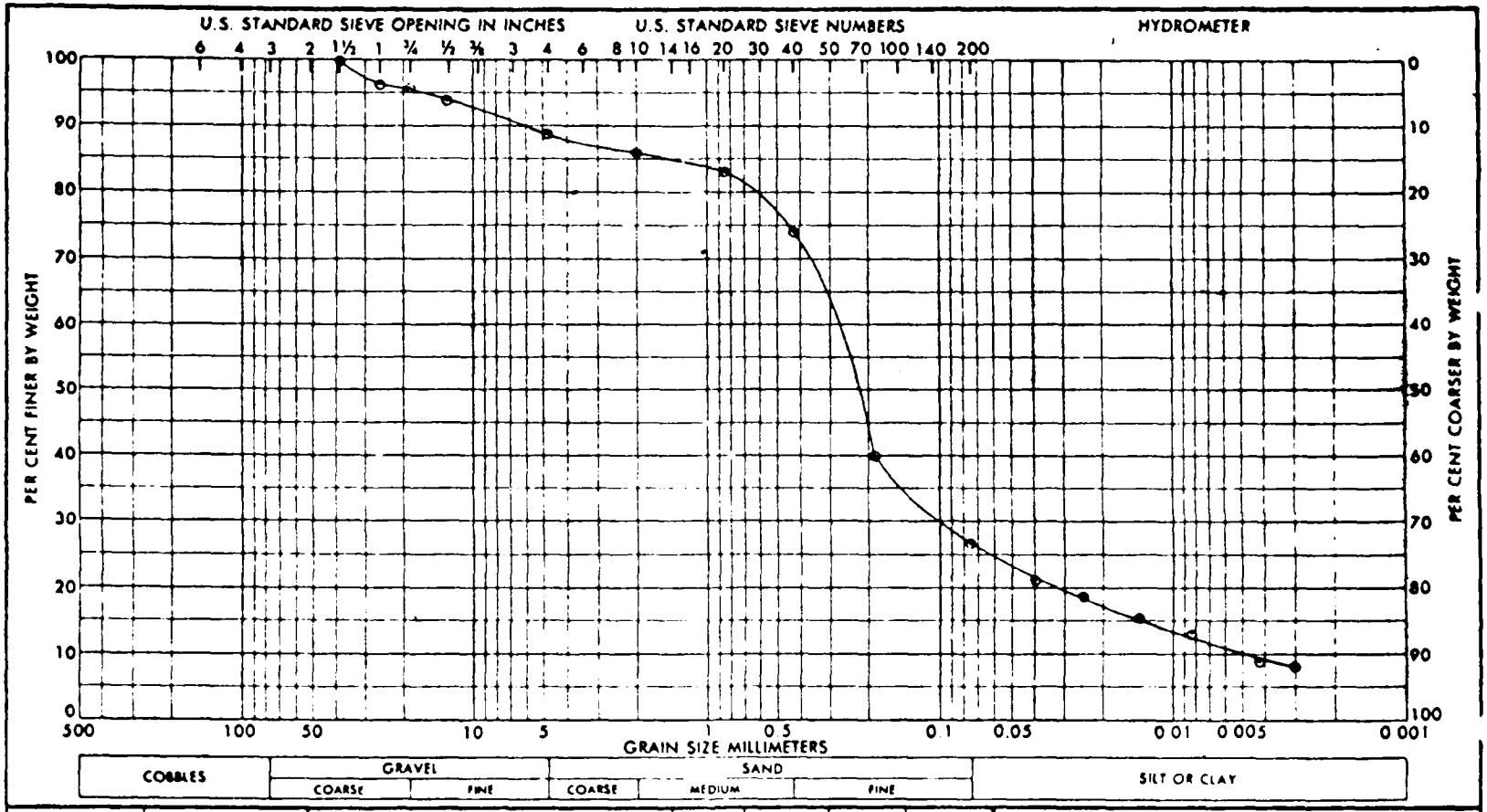
PROJECT Cedar River Harbor, Michigan

AREA

BORING NO. C-14

DATE September 1967

ENG FORM 2087 REPLACES WES FORM NO 1261 SEP 1962 WHICH IS OBSOLETE (TRANSLUCENT)



SAMPLE NO	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
B/C-5439	5.0'-7.5'	Clayey Sand (SC-SM)		(Visual)		

GRADATION CURVES

PROJECT Cedar River Harbor, Michigan

AREA

BORING NO CCR-516

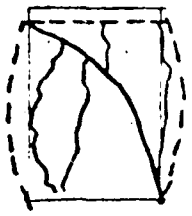
DATE September 1967

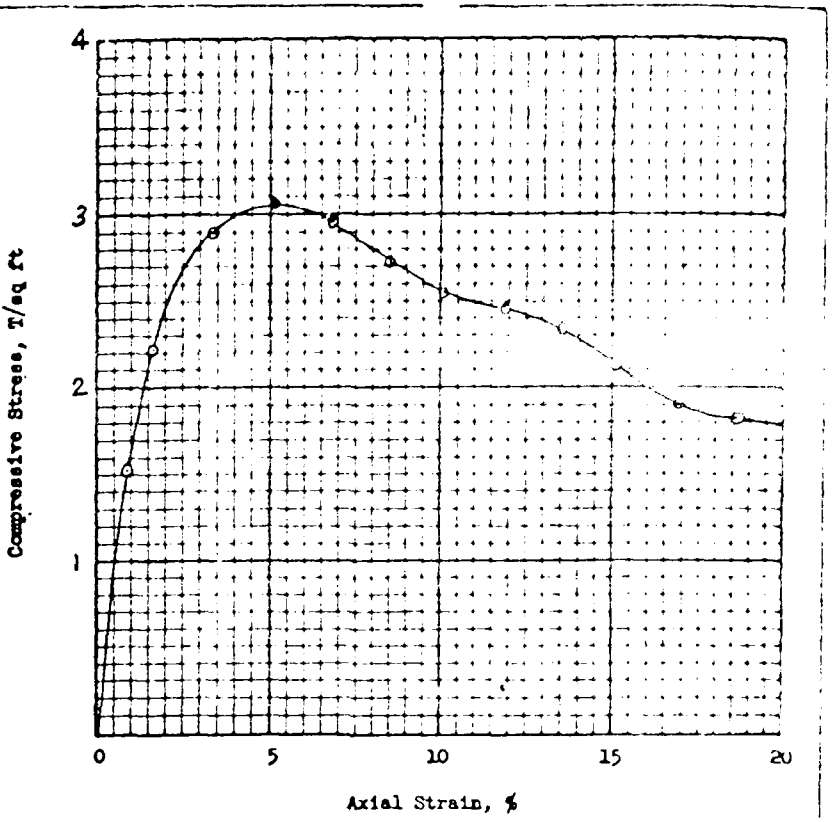
PLATE 13

ENG FORM 2087 (1 MAY 63) REPLACES WES FORM NO 1241, SEP 1962 WHICH IS OBSOLETE (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE 1963 O-700-128

Failure Sketches





☐ Controlled stress

☒ Controlled strain

Test No.						
Type of specimen			Und.			
Initial	Water content	w_o	15.3 %	%	%	%
	Void ratio	e_o	0.427			
	Saturation	S_o	98.1 %	%	%	%
	Dry density, lb/cu ft	γ_d	119.8			
Time to failure, min		t_f	5			
Unconfined compressive strength, T/sq ft		q_u	3.05			
Undrained shear strength, T/sq ft		s_u				
Rate of Strain			0.03in./min.			
Initial specimen diameter, in.		D_o	1.36			
Initial specimen height, in.		H_o	2.95			

Classification (Visual) Clay (CL)

LL 25 PL 14 PI 11 G_s 2.74

Remarks Test specimen taken from 0.69' to 1.07' of 1.44' tube sample.

Project Cedar River Harbor, Michigan

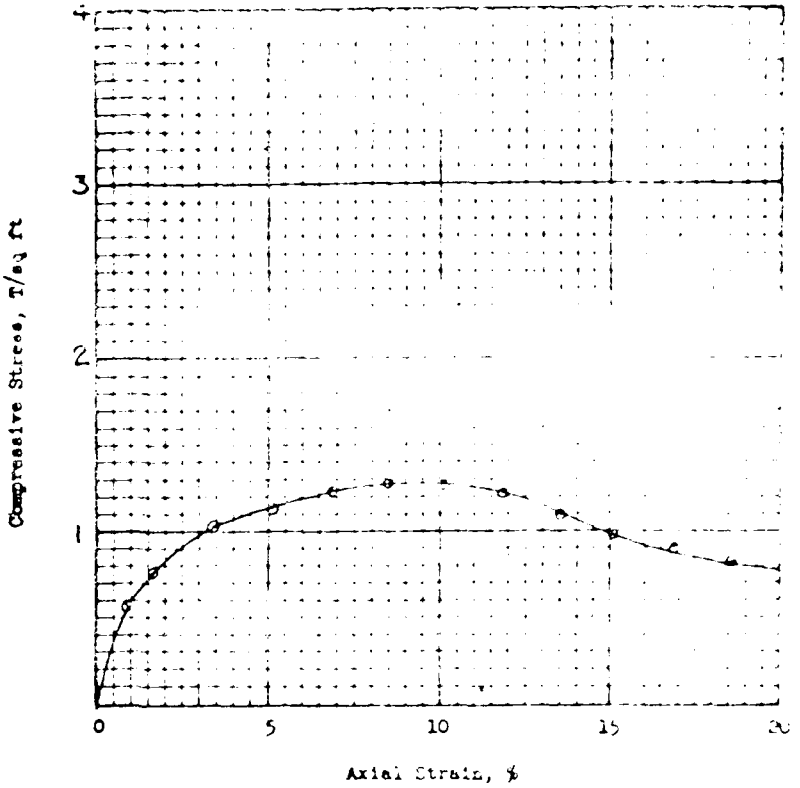
Area

Boring No. CCR-511 Sample No. 1/C-4753

Depth El 0.0' - 1.5' Date Sept. 1967

UNCONFINED COMPRESSION TEST REPORT

Failure Sketches



☐ Controlled stress

☒ Controlled strain

Test No.						
Type of specimen			Und.			
Initial	Water content	w_o	12.6 %	%	%	%
	Void ratio	e_o	0.360			
	Saturation	S_o	91.5 %	%	%	%
	Dry density, lb/cu ft	γ_d	124.8			
Time to failure, min		t_f	8			
Unconfined compressive strength, T/sq ft		q_u	1.28			
Undrained shear strength, T/sq ft		s_u				
~~Strain~~ Rate of Strain		S_R	0.03in./min.			
Initial specimen diameter, in.		D_o	1.37			
Initial specimen height, in.		H_o	2.96			

Classification (Visual) Sandy Clay (CL)

LL	PL	PI	G_s
18	11	7	2.76

Remarks Test specimen taken from 0.44' to 0.88' of 1.80' tube sample.

Section 1.39'-1.58' of 1.80' tube sample Clay (CL)

Project Cedar River Harbor, Michigan

Area

Boring No. CCR-511 | Sample No. 4/C-4754

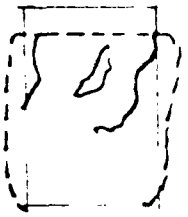
Depth El 7.0'-9.0' | Date Sept. 1967

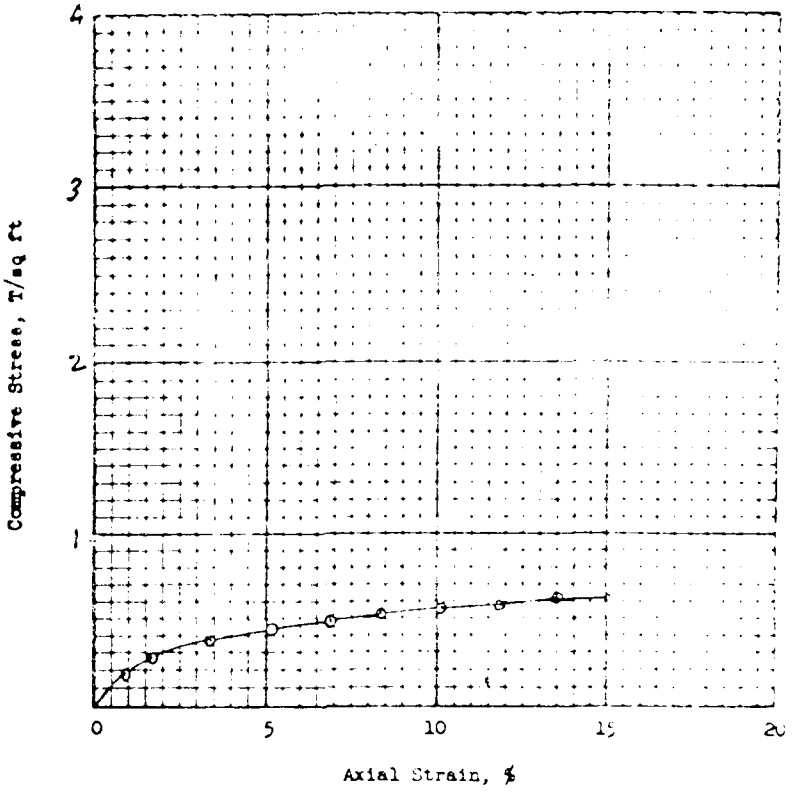
UNCONFINED COMPRESSION TEST REPORT

ENG FORM 1 JUN 68 3659

A23685 PLATE 15

Failure Sketches





☐ Controlled stress

☒ Controlled strain

Test No.						
Type of specimen			Unc			
Initial: Water content	w_o	12.5 %	%	%	%	%
Initial: Void ratio	e_o	0.351				
Initial: Saturation	S_o	96.9 %	%	%	%	%
Initial: Dry density, lb/cu ft	γ_d	125.6				
Time to failure, min	t_f	15				
Unconfined compressive strength, T/sq ft	q_u	0.62				
Undrained shear strength, T/sq ft	s_u					
~~Strain rate, in./min~~ Rate of Strain		XX 0.03in./min.				
Initial specimen diameter, in.	D_o	1.39				
Initial specimen height, in.	H_o	2.96				

Classification (Visual) Clayey Sand (SC)

LL	PL	PI	G_s
19	11	8	2.72

Remarks: Test specimen taken from top 0.42' of 1.85' tube sample.

Project: Cedar River Harbor, Michigan

Area:

Boring No. CCR-511 | Sample No. S/C-4755

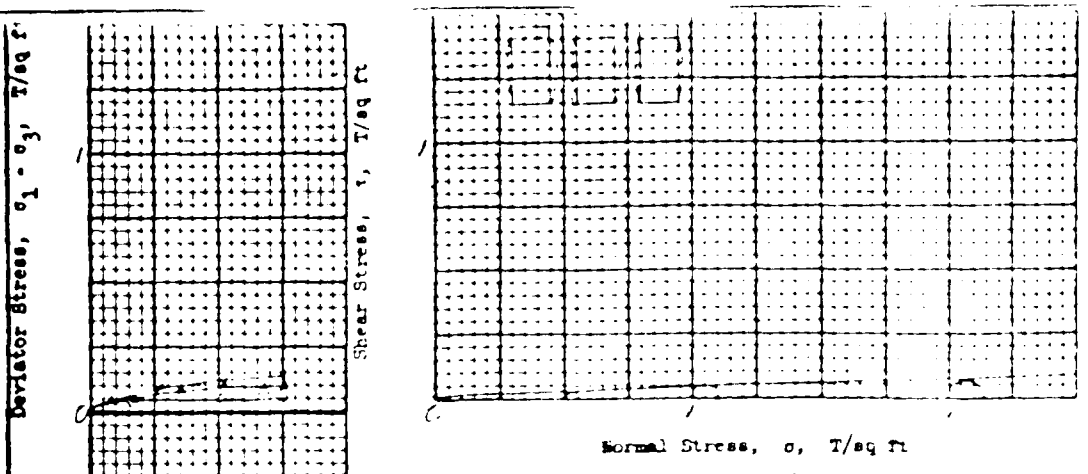
Depth El 9.5'-11.5' | Date Sept. 1967

UNCONFINED COMPRESSION TEST REPORT

ENG FORM 1 JUN 68 3659

A23655 PLATE 16

Copy original only



Test No.			1	2	3	
Initial	Water content	w_o	48.0 %	48.0 %	[illegible] %	%
	Void ratio	e_o	1.386	1.386	1.38[illegible]	
	Saturation	S_o	90.4 %	90.4%	[illegible]%	%
	Dry density, lb/cu ft	γ_d	68.3	68.3	[illegible]	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	σ_b				
Final	Water content	w_f	[illegible] %	[illegible] %	[illegible] %	%
	Void ratio	e_f	1.38[illegible]	1.38[illegible]	[illegible]	
Minor principal stress, T/sq ft		σ_3	[illegible]	1.0	[illegible]	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$		0.06	0.10	[illegible]	
Time to failure, min		t_f	12	15	[illegible]	
Rate of strain, percent/min			1.0	1.0	[illegible]	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$		0.06	0.10	0.1[illegible]	
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	2.95	2.95	2.95	

Shear Strength Parameters

ϕ = 1° 50'

tan ϕ = 0.033

c = 0.01 T/sq ft

Method of saturation None

☐ Controlled stress

☒ Controlled strain

Type of test Q | Type of specimen Remolded

Classification Organic Sandy Silt (OL)

LL 47 | PL 30 | PI 17 | | G_s 2.61

Remarks Test specimens remolded by kneading compaction to min. density

Project Cedar River Harbor, Michigan

Area

Boring No. CCR-503 | Sample No. 9/C-5426

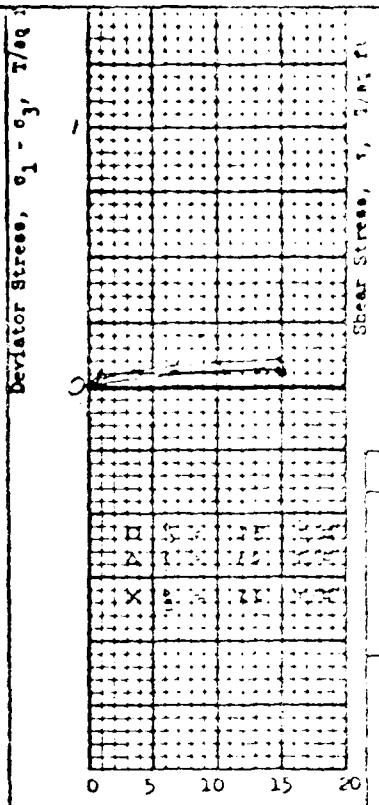
Depth El 19.0' - 22.0' | Date Sept. 1967

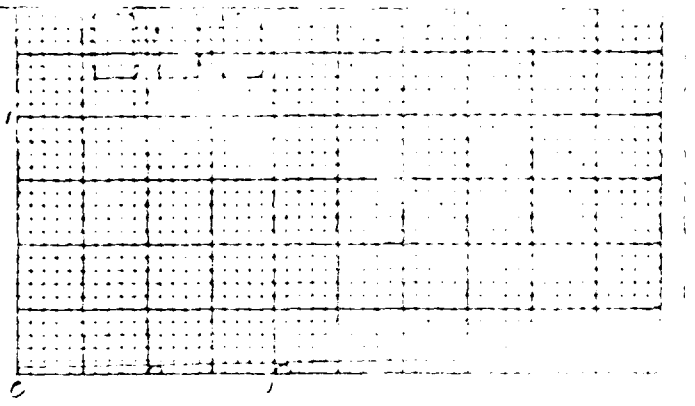
TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 69 2089 (EM 1110-2-1902) PREVIOUS EDITIONS ARE OBSOLETE

PLATE 17

TRANSLUCENT





Test No.			1	2	3	
Initial	Water content	w_o	47.9%	48.0%	%	%
	Void ratio	e_o	1.344	1.345		
	Saturation	S_o	93.0%	93.1%	%	%
	Dry density, lb/cu ft	γ_d	69.5	69.3		
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_b				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f	1.344	1.345		
Minor principal stress, T/sq ft		σ_3	0.5	1.0		
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$		0.07	0.07	0.1	
Time to failure, min		t_f	13	13	13	
Rate of strain, percent/min			1.0	1.0	1.0	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$		0.07	0.06	0.1	
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	2.95	2.95	2.95	

Shear Strength Parameters

ϕ = 0 50'

tan ϕ = 0.014

c = 0.03 T/sq ft

Method of saturation None

☐ Controlled stress

☐ Controlled strain

Type of test Q | Type of specimen Remolded

Classification Organic Sandy Silt (OL)

LL 47	PL 30	PI 17		G_s 2.61

Remarks Test specimen remolded by kneading compaction to max. density at field moisture.

Project Cedar River Harbor, Michigan

Area

Boring No. CCR-SD3 | Sample No. 9/C-542e

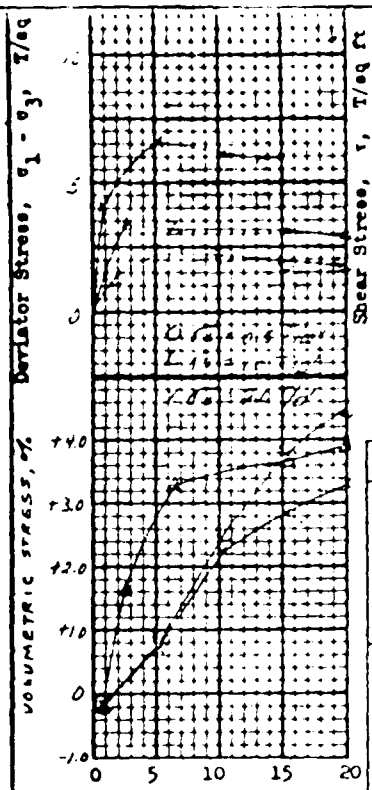
Depth Ft 19.0' - 22.0' | Date Sept. 1967

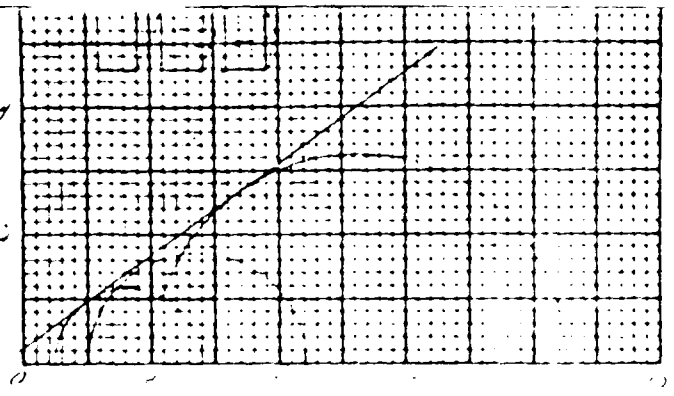
TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 69 2089 (EM 1110-2-1902) PREVIOUS EDITIONS ARE OBSOLETE

PLATE 18

TRANSLUCENT





Test No.			1	2	3	
Initial	Water content	w_o	12.0 %	12.0 %	12.0 %	%
	Void ratio	e_o	0.561	0.539	0.563	
	Saturation	S_o	57.4 %	59.7 %	57.2 %	%
	Dry density, lb/cu ft	γ_d	107.2	108.7	107.1	
Before Shear	Water content	w_c	20.1 %	19.5 %	19.6 %	%
	Void ratio	e_c	0.557	0.533	0.554	
	Saturation	S_c	96.7 %	97.9 %	96. %	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	22.7 %	21.7 %	19.4 %	%
	Void ratio	e_f	0.627	0.593	0.6[illegible]	
Minor principal stress, T/sq ft		σ_3	0.5	1.0	2.0	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	2.31	3.43	6.52	
Time to failure, min		t_f	27	13	25	
Rate of strain, percent/min			0.2	0.2	0.2	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$	1.98	3.07	5.99	
Initial diameter, in.		D_o	1.39	1.40	1.40	
Initial height, in.		H_o	2.95	2.95	2.95	

Shear Strength Parameters

ϕ = 35°40'

tan ϕ = 0.718

c = 0.22 T/sq ft

Method of saturation Seepage

☐ Controlled stress

☒ Controlled strain

Type of test S	Type of specimen Remolded			
Classification Sand (SP-SM)				
LL	PL	PI		G_s 2.66

Remarks: Test specimens remolded by kneading & vibration compaction to high density @ field moisture

Project: Cedar River Harbor

Area

Boring No. CCR 506 | Sample No. 9/C-5429

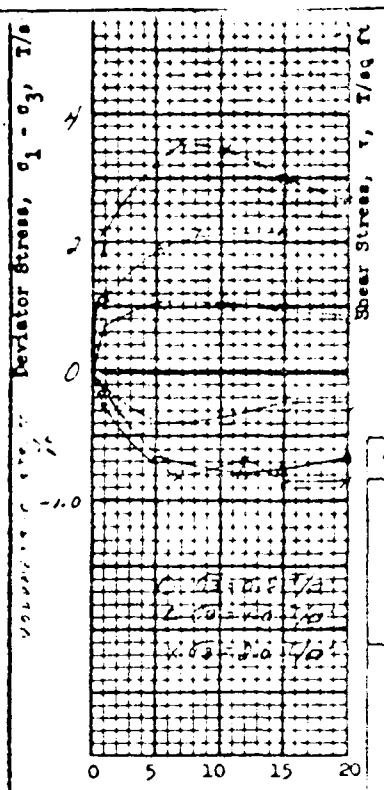
Depth 20.0-22.5 | Date September 1967

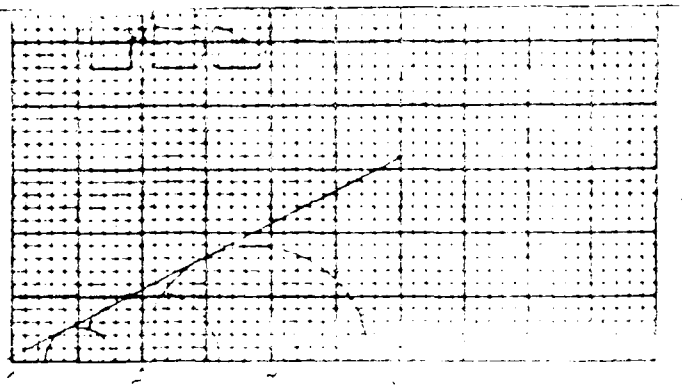
TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 (EM 1110-2-1902) PREVIOUS EDITIONS ARE OBSOLETE

PLATE 19

TRANSLUCENT





Test No.			1	2	3	
Initial	Water content	w_o	12.0 %	12.0%	12.0%	%
	Void ratio	e_o	0.739	0.739	0.739	
	Saturation	S_o	43.5%	43.5%	43.5%	%
	Dry density, lb/cu ft	γ_d	96.2	96.2	96.2	
Before Shear	Water content	w_c	26.0%	28.0%	28.2%	%
	Void ratio	e_c	0.727	0.739	0.743	
	Saturation	S_c	96.0%	94.2%	94.2%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	25.4%	25.2%	25.7%	%
	Void ratio	e_f	0.723	0.718	0.728	
Minor principal stress, T/sq ft		σ_3	0.5	1.0	2.0	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	1.07	2.18	3.97	
Time to failure, min		t_f	25	25	25	
Rate of strain, percent/min			0.2	0.2	0.2	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$	0.97	2.18	3.97	
Initial diameter, in.		D_o	2.87	2.87	2.87	
Initial height, in.		H_o	6.00	6.00	6.00	

Shear Strength Parameters

ϕ = 26 ° 0'

tan ϕ = 0.503

c = 0.08 T/sq ft

Method of saturation seepage

☐ Controlled stress

☒ Controlled strain

Type of test S	Type of specimen Remolded			
Classification Sand (SP-SM)				
LL	PL	PI		G_s 2.68

Remarks Test specimen remolded by kneading compaction to low density at field moisture

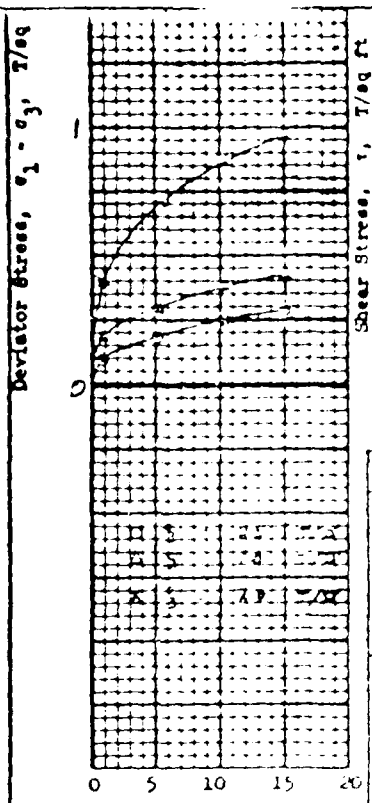
Project Cedar River Harbor

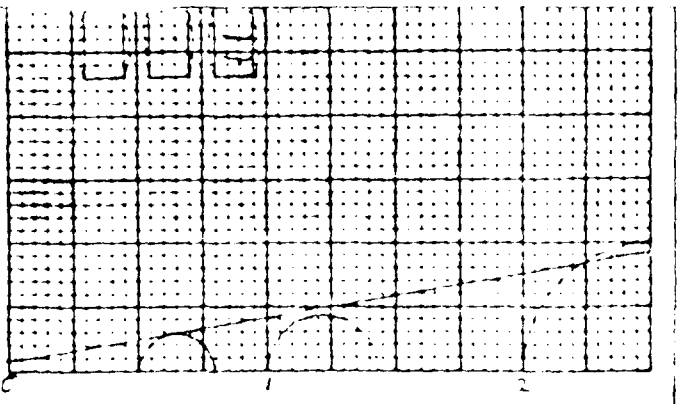
Area

Boring No. CCR 506 | Sample No. 9/C-5429

Depth 20.0-22.5 | Date September 1967

TRIAXIAL COMPRESSION TEST REPORT





Test No.			1	2	3	
Initial	Water content	w_c	11.2 %	11.0 %	10.9 %	%
	Void ratio	e_o	0.452	0.451	0.450	
	Saturation	S_o	67.7 %	66.7 %	66.2 %	%
	Dry density, lb/cu ft	γ_d	117.3	117.4	117.5	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_b				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor prin. stress, T/sq ft		σ_3	0.5	1.0	1.5	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$		0.29	0.43	0.58	
Time to failure, min		t_f	15	15	15	
Rate of strain, percent/min			1.0	1.0	1.0	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$		0.29	0.43	0.58	
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	2.95	2.95	2.95	

Shear Strength Parameters

ϕ = 9°10'

tan ϕ = 0.163

c = 0.04 T/sq ft

Method of saturation None

☐ Controlled stress

☒ Controlled strain

Type of test Q | Type of specimen Remolded

Classification (Visual) Silty Sand (SM)

LL	PL	PI		G_s 2.63

Remarks Test specimens remolded by kneading compaction to minimum density at field moisture

Project Cedar River Harbor, Michigan

Area

Boring No. CCR-510 | Sample No. 7/C-5435

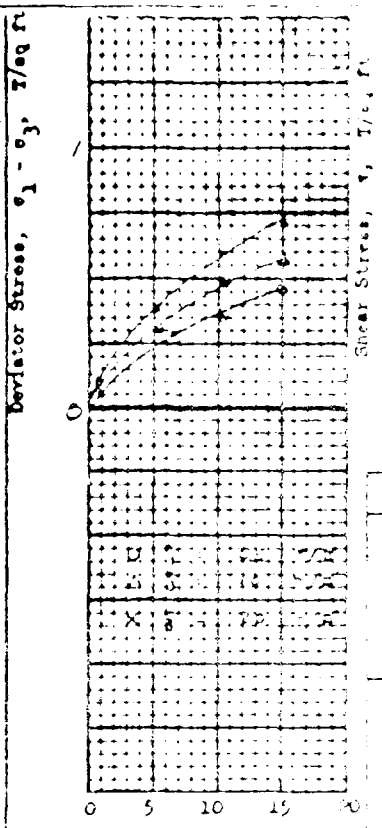
Depth El 15.0'-17.5' | Date Sept. 1967

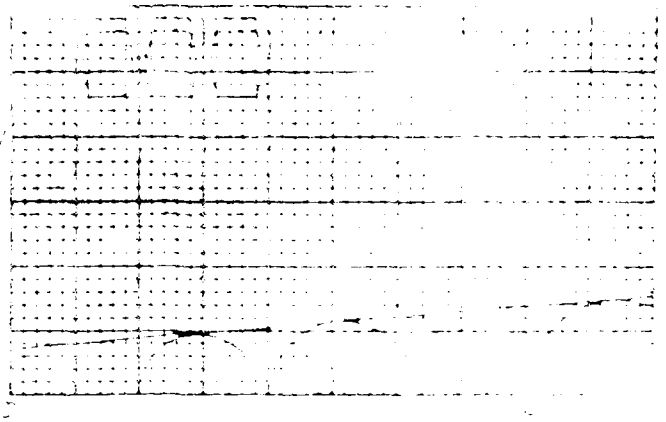
TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 (EM 1110-2-1902) PREVIOUS EDITIONS ARE OBSOLETE

PLATE 21

TRANSLUCENT





Shear Strength Parameters

ϕ = [illegible]°

tan ϕ = [illegible]

c = 0.15 T/sq ft

Method of saturation: None

☐ Controlled stress

☒ Controlled strain

Test No.		1	2	3	
Initial	Water content	w_o	[illegible] %	[illegible] %	%
	Void ratio	e_o	[illegible]	[illegible]	
	Saturation	S_o	[illegible] %	[illegible] %	%
	Dry density, lb/cu ft	γ_d	[illegible]	[illegible]	
Before Shear	Water content	w_c	%	%	%
	Void ratio	e_c			
	Saturation	S_c	%	%	%
	Final back pressure, T/sq ft	σ_3			
Final	Water content	w_f	[illegible] %	[illegible] %	%
	Void ratio	e_f	[illegible]	[illegible]	
Minor principal stress, T/sq ft		σ_3	[illegible]	[illegible]	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	[illegible]	[illegible]	
Time to failure, min		t_f	[illegible]	[illegible]	
Rate of strain, percent/min			[illegible]	[illegible]	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$	0.44	0.88	
Initial diameter, in.		D_o	1.83	1.82	
Initial height, in.		H_o	2.95	2.95	

Type of test: Q | Type of specimen: Remolded

Classification: (Visual) Silty Sand (SM)

LL | PL | PI | G_s [illegible]

Remarks: Test specimens remolded by kneading compaction to maximum density at field moisture

Project: Cedar River Harbor, Michigan

Area

Boring No. CCR-510 | Sample No. [illegible]

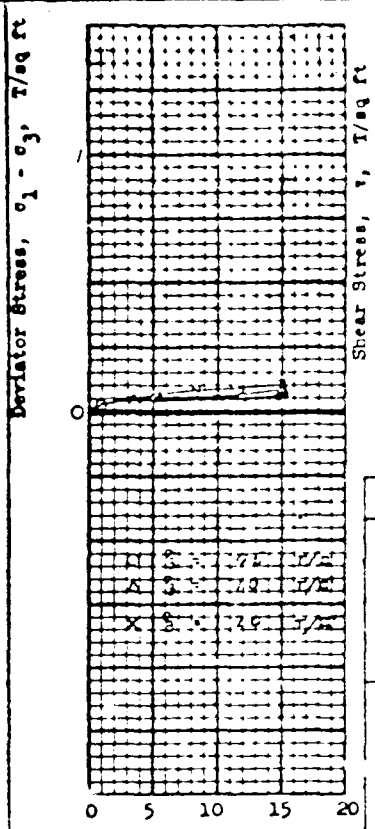
Depth El [illegible] to [illegible]

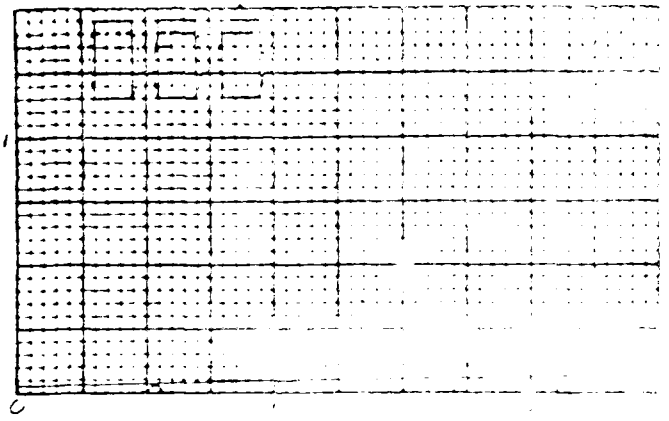
TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 55 2089 (EM 1110-2-1902) PREVIOUS EDITIONS ARE OBSOLETE

PLATE 22

TRANSLUCENT





Test No.			1	2	3	
Initial	Water content	w_c	[illegible] %	[illegible] %	%	%
	Void ratio	e_c	2.160	2.030	[illegible]	
	Saturation	S_o	[illegible] %	88.7 %	%	%
	Dry density, lb/cu ft	γ_d	51.3	51.4	[illegible]	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	72.2 %	[illegible] %	%	%
	Void ratio	e_f	2.160	2.030	[illegible]	
Minor principal stress, T/sq ft		σ_3	0.5	1.0	[illegible]	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$		0.06	0.08	0.[illegible]	
Time to failure, min		t_f	13	13	13	
Rate of strain, percent/min			1.0	1.0	1.0	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$		0.06	0.08	0.[illegible]	
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	2.95	2.95	2.95	

Shear Strength Parameters

ϕ = 1° 10'

tan ϕ = 0.019

c = 0.02 T/sq ft

Method of saturation None

☐ Controlled stress

☒ Controlled strain

Type of test Q | Type of specimen Remolded

Classification Organic Sandy Silt (OH)

LL 76 | PL 33 | PI 43 | | G_s [illegible]

Remarks Test specimens remolded by kneading compaction to min. density at field moisture.

Project Cedar River Harbor, Michigan

Area

Boring No. CCR-513 | Sample No. S/C-5437

Depth El 10.0'-12.2' | Date Sept. 196[illegible]

TRIAXIAL COMPRESSION TEST REPORT

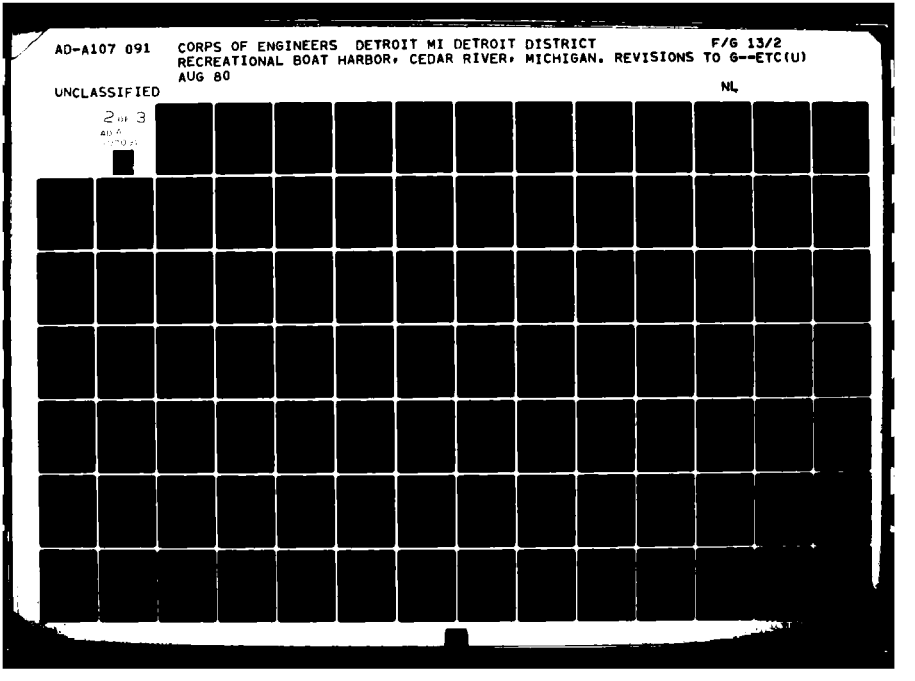
ENG FORM 1 JUN 65 2089 (EM 1110-2-1902) PREVIOUS EDITIONS ARE OBSOLETE

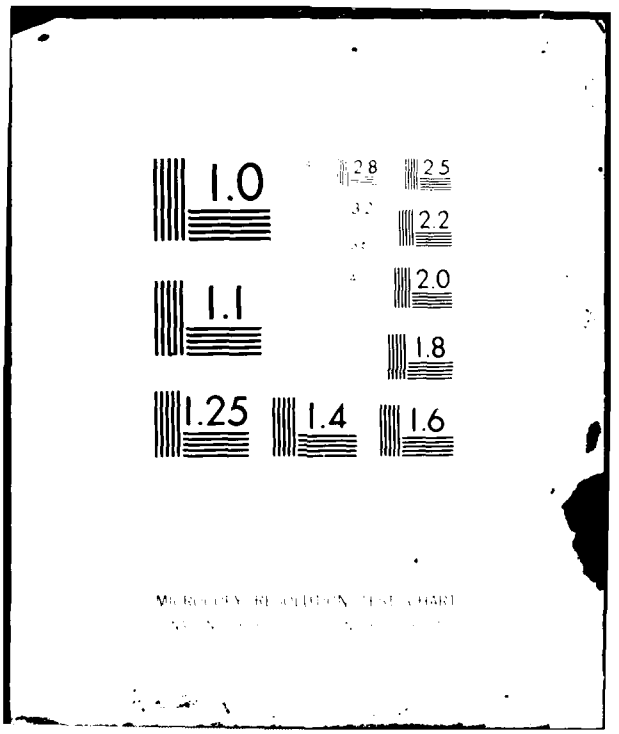
TRANSLUCENT

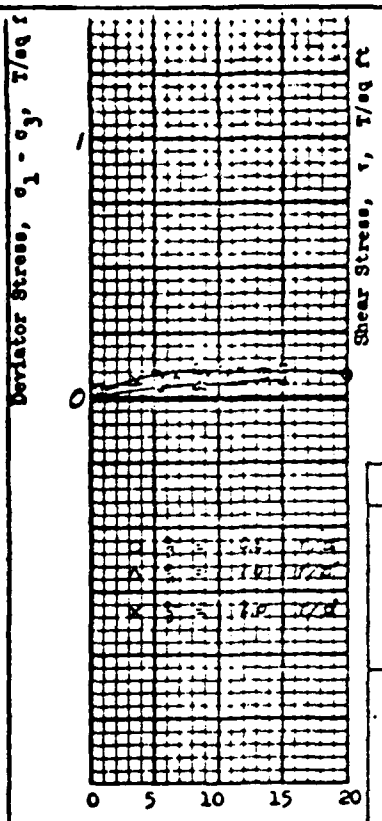
PLATE 23

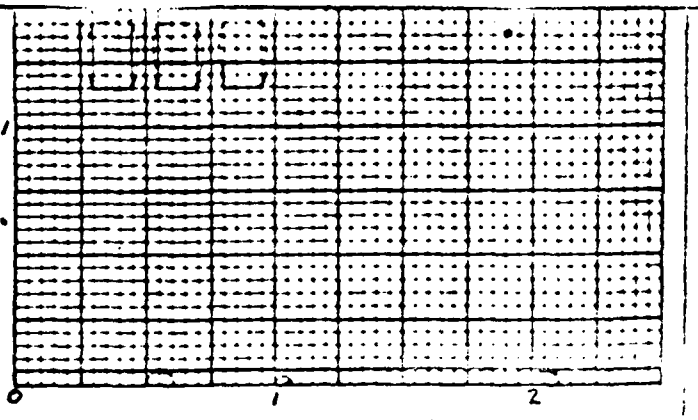
AD-A107 091 CORPS OF ENGINEERS DETROIT MI DETROIT DISTRICT F/G 13/2
RECREATIONAL BOAT HARBOR, CEDAR RIVER, MICHIGAN. REVISIONS TO G--ETC(U)
AUG 80

UNCLASSIFIED NL




1.0
1.1
1.25
1.4
1.6
2.0
1.8
2.2
2.5





Test No.			1	2	3	
Initial	Water content	w_o	70.8 %	71.5%	71.6%	%
	Void ratio	e_o	1.902	1.914	1.915	
	Saturation	S_o	96.8 %	97.1 %	97.2%	%
	Dry density, lb/cu ft	γ_d	55.9	55.7	55.6	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	70.8 %	71.5%	71.6%	%
	Void ratio	e_f	1.902	1.914	1.915	
Minor principal stress, T/sq ft		σ_3	0.5	1.0	2.0	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$		0.11	0.07	0.11	
Time to failure, min		t_f	8	12	13	
Rate of strain, percent/min			1.0	1.0	1.0	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$		0.09	0.07	0.11	
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	2.95	2.95	2.95	

Shear Strength Parameters

ϕ = - °

tan ϕ = -

c = 0.06 T/sq ft

Method of saturation None

☐ Controlled stress

☒ Controlled strain

Type of test Q | Type of specimen Remolded

Classification Organic Sandy Silt (OH)

LL 76 | PL 33 | PI 43 | | G_s 2.60

Remarks Test specimens remolded by kneading compaction to maximum density at field moisture.

Project Cedar River Harbor, Michigan

Area

Boring No. CCR-513 | Sample No. S/C-5437

Depth El 10.0' - 12.2 | Date Sept. 1967

TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 69 2089 (EM 1110-2-1902) PREVIOUS EDITIONS ARE OBSOLETE

PLATE 24

TRANSLUCENT

TEST DATA SUMMARY

FEATURE Cedar River Harbor, Michigan

SAMPLE NO. C-C-R	TEST NO.	DEPTH OF SAMPLE, FT.	CLASSIFICATION	MECHANICAL ANALYSIS % GRAVEL	% SAND	% SILT	% CLAY	ATTERBERG LIMITS LL	PL	SPECIFIC GRAVITY	MAX. WATER CONT. %	NATURAL WATER CONTENT %	NATURAL DRY DENSITY LBS/CU FT	COMPACTION DATA DRY DENSITY LBS/CU FT	MAXIMUM DRY DENSITY LBS/CU FT	SHEAR DATA INITIAL	DRY DENSITY	%	%	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ3 TSF	σ1 TSF	σ3 TSF	σ1 REMARKS	PERMEABILITY K	K ATTEMPS	CONSOLIDATION DATA σ1 TSF	σ2 TSF	σ3 TSF	σ4 TSF
S00	1	00-3.5	SP (Visual)																													
	2	3.5-6.1	SP	"																												
	3	6.1-8.5	SP	"																												
	4	8.6-11.5	SP	"																												
	5	11.6-12.1	ML-CL	"	25	15	35																									
	6	12.1-14.8	SM-GC	"	35	30	35																									
	7	14.8-16.25	SM-SC	"	15	45	40																									
S01	1	00-1.8	SM	"	40	45	15																									
	2	1.8-3.2	SM	"		60	20	20% decay of wood																								
	3	3.5-6.3	SP	"																												
	4	10.8-12.1	SM-SC	"	30	40	30																									
	5	14.2-17.8	GM-GC	"	50	30	20																									
	6	18.8-21.8	SM	"	30	40	30																									
S02	1	00-2.5			60	35	5	(60% is wooden box gravel)																								
	2	2.5-5.0	SM-SP	"	10	80	10	(small wood fragments)																								
	3	5.0-7.5	SP	"	5	65	30	(wood fragments)																								
	4	7.5-10.0	SP	"	60	40		(60% wood fragments)																								
S03	1	00-3.0	(Visual)	(Wood chunks)																												
	2	3.0-5.0		"																												
	3	5.0-7.5	SP-SM	"		95	5																									
	4	7.5-10.0	SP-SM	"		95	5																									
	5	10.0-12.0	SP-SM	"		95	5																									
	6	12.0-17.5	SP-SM	"		95	5																									
	7	17.5-18.1	SP	"	1	96	3																									
	8	22.0-22.0				31	27		47	30	2.61					1386	68.3	48.0	48.0	90.9	UU	1.40x2.95	1	0.5	0.56	0.01	0.50					
																1386	68.3	48.0	48.0	90.4	UU	1.40x2.95	2	1.0	1.18							
																1384	68.3	47.9	47.9	90.3	UU	1.40x2.95	3	2.0	2.14							
																1344	69.5	47.9	47.9	91.0	UU	1.40x2.95	1	0.5	0.52	0.03	0.50					
									47	30	2.61					1345	69.5	48.0	48.0	93.1	UU	1.40x2.95	2	1.0	1.07							
																1344	69.5	47.9	47.9	92.0	UU	1.40x2.95	3	2.0	2.11							
S04	1	00-2.5	SP-SM	(Visual)		95	5																									
	2	2.5-5.0	SP	"	4	92	4																									
	3	5.0-7.5	SC-SM	"	1	81	18																									
	4	7.5-10.0	SC-SM	"	1	81	18																									

ENG FORM 2086 (PREVIOUS EDITIONS MAY BE USED) (TRANSLUCENT)

TC – Triaxial Compression
UC – Unconfined Compression
DS – Direct Shear
UU – Unconsolidated Undrained
CD – Consolidated Drained
CU – Consolidated Undrained
* Values at Pressure

Plate 25

TEST DATA SUMMARY

FEATURE Cedar River Harbor, Michigan

Sample No.	Depth in Feet	Classification	Gravel %	Sand %	Silt & Clay %	LL	PI	Specific Gravity	Nat. Water Content %	Nat. Dry Density lbs/cu ft	Comp. Dry Density lbs/cu ft	Comp. Water Content %	Initial Dry Density lbs/cu ft	Initial Water Content %	Initial Void Ratio	Initial Saturation %	Test Type	Specimen Size	Test No.	Shear Strength σ_1 1.00 tsf	Shear Strength σ_1 2.00 tsf	Shear Strength σ_1 4.00 tsf	Shear Strength σ_1 8.00 tsf	Shear Strength ϕ degrees	Permeability e	Permeability cm/sec	Consolidation Data σ_c 1.00 tsf	Consolidation Data σ_c 2.00 tsf	Consolidation Data σ_c 4.00 tsf	Consolidation Data σ_c 8.00 tsf	Consolidation Data C_c	Consolidation Data C_r
SC4	1	0.0-2.5 SC-SM (gravelly)	1	79	20																										
	2	2.5-6.0 SC-SM	1	64	35																										
	3	6.0-12.5 SC-SM	1	64	35																										
	4	12.5-20.0 SC-SM	1	69	30																										
SC5	1	0.0-1.5 SM-SP			90	10																									
	2	1.5-4.0 SM	1	84	15																										
	3	4.0-6.5 SM	5	80	15																										
	4	6.5-8.5 SM	5	80	15																										
	5	8.5-11.5 SM-SP	1	89	10																										
	6	11.5-14.0 SM	1	79	20																										
	7	14.0-16.5 SM		70	30																										
SC6	1	0.0-3.0 SP	1	98	1																										
	2	3.0-5.0 SP	1	97	2																										
	3	5.0-7.5 SM-SP	10	80	10																										
	4	7.5-10.0 SP-SM	3	92	5																										
	5	10.0-12.5 SM-SP	10	80	10																										
	6	12.5-15.0 SM-SP	5	85	10																										
	7	15.0-17.5 SM	5	80	15																										
	8	17.5-20.0 SM	3	82	15																										
	9	20.0-22.5 SP-SM	1	93	6			2.68					0.739	96.2	12.0	36.9	46.5	CD	1.40 x 2.95	1	0.5	1.57	0.68	26.0°							
													0.739	96.2	12.0	36.2	46.5	CD	1.40 x 2.95	2	1.0	2.18								
										Sample no. 9			0.740	96.1	12.0	37.7	48.5	CD	1.39 x 2.95	3	2.0	4.64								
	10	22.5-25.0 SM	2	82	15								0.561	107.2	12.0	32.7	52.4	CD	1.39 x 2.95	1	0.5	0.81	0.23	25.0°							
	11	25.0-27.5 SM	1	84	15								0.638	108.7	12.0	36.7	58.7	CD	1.40 x 2.95	2	1.0	1.93								
	12	27.5-30.2 SM	3	82	15								0.563	107.1	12.0	38.9	57.2	CD	1.40 x 2.95	3	2.0	3.58								
	13	30.0-32.0 SM	5	80	15																										
SC7	1	0.0-2.5 SP-SM	1	94	5																										
	2	2.5-5.0 SM-SP	1	89	10																										
	3	5.0-8.1 SM-SP	1	89	10																										
	4	8.1-10.0 SP-SM	1	93	6																										
	5	10.0-13.1 SP-SM	1	94	5																										
	6	13.1-15.0 SM-SP	1	89	10																										
	7	15.0-18.1 SM-SP	1	89	10																										
	8	18.1-20.0 SP-SM	1	94	5																										
	9	20.0-23.1 SM-SP	1	89	10																										
	10	23.1-25.5 SM	1	84	15																										
	11	25.5-28.1 SM	1	84	15																										

TC = Triaxial Compression
UC = Unconfined Compression
DS = Direct Shear
UU = Unconsolidated Undrained
CU = Consolidated Undrained

Plate 26

TEST DATA SUMMARY

FEATURE Cedar River Harbor, Michigan

[illegible]	1	0.0-2.3	SM-SP (visual)		1	89	10																		
	2	2.3-5.0	SM	"	15	70	15																		
	3	5.0-7.5	SM-SP	"	20	70	10																		
	4	7.5-10.0	SC-SP	"	2	87	10																		
	5	10.0-12.5	SC	"	3	79	18																		
	6	12.5-15.0	SC	"	3	67	20																		
	7	15.0-17.5	SC	"	3	82	15																		
	8	17.5-20.0	SP-SM	"	3	92	5																		
5E0	1	0.0-2.2	SP-SM	"		95	5																		
	2	2.2-5.0	GP	"	54	43	3																		
	3	5.0-7.8	SP	"	5	91	4																		
	4	7.8-10.0	SM	"	14	56	30																		
	5	10.0-12.8	SP-SM	"	20	75	5																		
	6	12.5-12.8	SP-SM	"	7	87	6																		
	7	12.8-16.0	SP-SM	"	15	79	6																		
	8	16.0-17.8	SP-SM	"	5	89	6																		
	9	17.8-20.0	SP-SM	"	3	92	5																		
	10	20.0-22.8	SP-SM	"	2	93	5																		
[illegible]	1	2.0-2.5	SP-SM	"		95	5																		
	2	2.5-5.0	SP-SM	"		95	5																		
	3	5.0-7.5	SP-SM	"		95	5																		
	4	7.5-10.0	SP-SM	"		95	5																		
	5	10.0-12.5	SP-SM	"		95	5																		
	6	10.0-15.0	SM	Lab.	5	53	42	18	13		11.3														
	7	5.0-12.5	SM	(visual)	5	53	42			2.73		Sample no. 7	0.452	117.3	11.2	11.2	67.7	UU	1.40x2.95	1	0.5	0.79	0.04	9°-10'	Remo… to min. densi…
													0.451	117.4	11.0	11.0	66.7	UU	1.40x2.95	2	1.0	1.43			Field moistu…
	8	15.0-22.0	SC	"	1	64	35						0.450	117.5	10.9	10.9	66.2	UU	1.40x2.95	3	2.0	2.98			
	9	22.0-22.5	SM-SC	"	1	74	25						0.328	128.3	11.1	11.1	92.9	UU	1.40x2.95	1	0.5	0.96	0.18	41°-20'	Remo…
	10	22.5-25.0	SM-SC	"	3	72	25						0.327	128.4	11.0	11.0	92.9	UU	1.40x2.95	2	1.0	1.57			to max. densi…
													0.330	128.1	11.3	11.3	92.9	UU	1.40x2.95	3	2.0	2.74			Field moistu…
5	1	2.0-2.5	CL	Lab.		5	95	26	14	2.74	15.3		0.427	119.8	15.3	—	98.1	UC	1.86x2.95	1	—	—	3.05 (qu)		
	2	2.5-4.2	CL-ML (visual)			10	90																		
	3	4.2-6.5	CL-ML	"		15	85																		
	4	6.8-7.2	CL	"	6	40	54	18	11	2.76	12.6		0.380	124.8	12.6	—	96.5	UC	1.37x2.96	1	—	—	1.28 (qu/2)		
		7.2-8.5	CL	"		4	96																		
	5	8.5-11.5	SC	"	12	40	48	19	11		12.5		0.351	125.6	12.5	—	92.9	UC	1.39x2.96	1	—	—	0.62 (qu/2)		

ENG FORM 2086 (PREVIOUS EDITIONS MAY BE USED) (TRANSLUCENT)

TC – Triaxial Compression; UC – Unconfined Compression; DS – Direct Shear; UU – Unconsolidated Undrained; CD – Consolidated Drained; CU – Consolidated Undrained; *Values at Pressure

Plate 27

TEST DATA SUMMARY

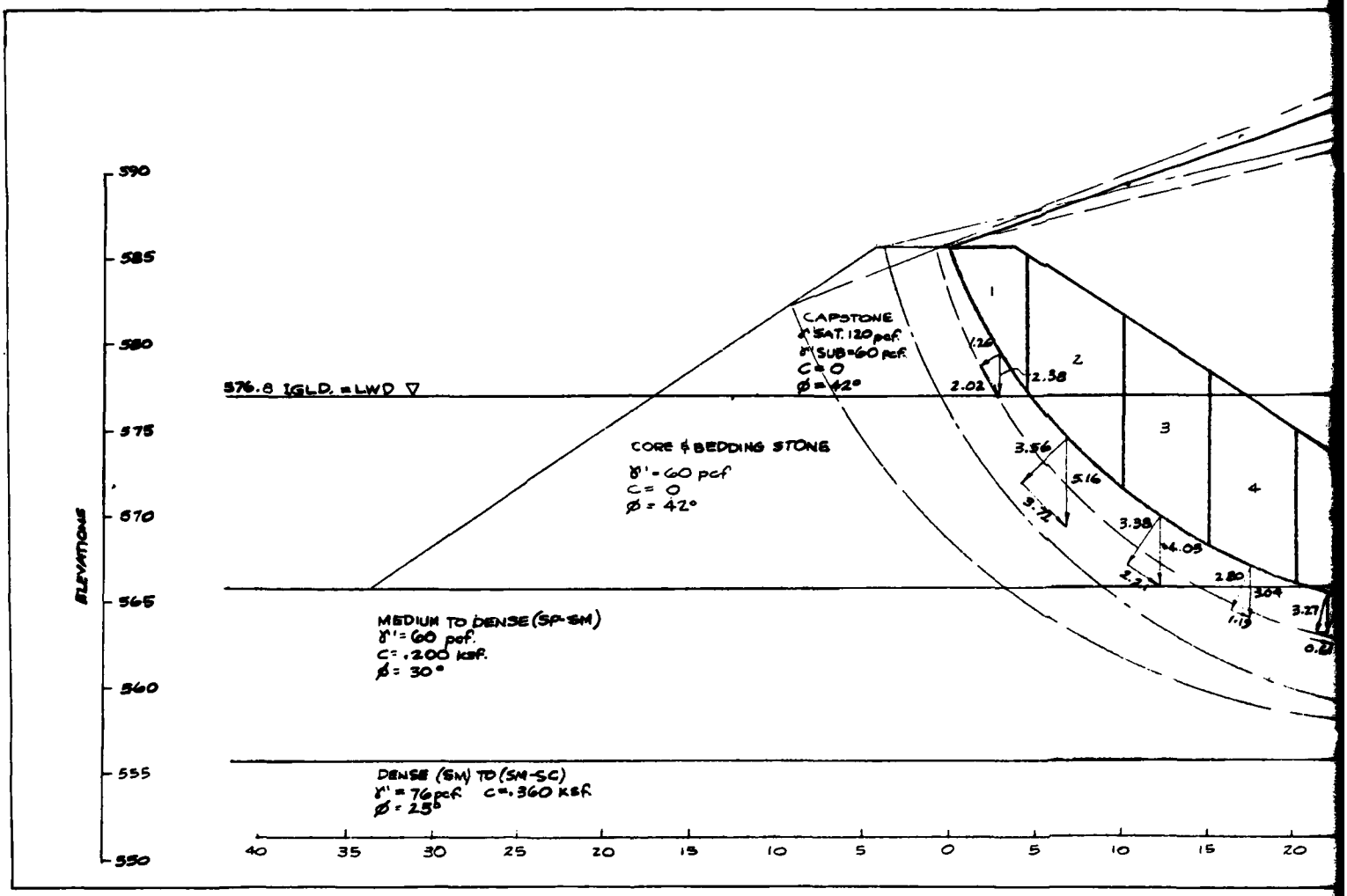
FEATURE Cedar River Harbor, Michigan

SAMPLE NO.	DEPTH OR ELEV. OF SAMPLE	CLASSIFICATION	MECHANICAL ANALYSIS: GRAVEL %	SAND %	FINES %	D10 mm	ATTERBERG LIMITS: LL	PL	NATURAL MOISTURE CONTENT %	NATURAL DRY DENSITY LBS CU FT	COMPACTION DATA: DRY DENSITY LBS CU FT	OPTIMUM MOISTURE %	SHEAR DATA: INITIAL MOISTURE %	INITIAL DRY DENSITY LBS CU FT	σ_3	σ_1	σ_3	TYPE TEST	SPECIMEN SIZE INCHES	TEST	τ_{100} PSF	τ_{200} PSF	τ_{300} PSF	τ_{400} PSF	DEFORMATION %	PERMEABILITY: K	RETURN	CONSOLIDATION DATA: σ_1	σ_2	σ_3	σ_4
S-2	1 0.0-1.0	SP-SM (Fraud)		95	5																									
	2 1.0-3.0	SP-SM	"	95	5																									
	3 3.0-4.0	SP-SM	"	95	5																									
	4 4.0-6.5	SP-SM	"	95	5																									
	5 6.5-8.5	SP-SM	"	95	5																									
S-3	1 0.0-2.5	SP-SM	"	95	5																									
	2 2.5-4.0	SP-SM	"	95	5																									
	3 4.0-7.0	SP-SM	"	95	5																									
	4 7.0-10.0	SM-SC	"	89	41	36																								
	5 10.0-12.0	CH		1	24	75	76	33	0.60	72			2.140	51.3	71.2	72.2	84.9	UU	1.40 X 2.95	1	0.5	0.82	0.82	1.18						
													2.030	51.4	71.2	72.2	82.7	UU	1.40 X 2.95	2	1.0	1.68							
													2.145	51.6	71.2	71.2	84.4	UU	1.40 X 2.95	3	2.0	2.11							
													1.902	55.9	70.8	70.8	78.8	UU	1.40 X 2.95	1	0.5	0.61	0.66	—					
													1.914	55.7	71.5	71.6	82.1	UU	1.40 X 2.95	2	1.0	1.07							
													1.915	55.6	71.6	71.6	82.2	UU	1.40 X 2.95	3	2.0	2.11							
	6 12.0-16.0	GC-GM		33	20	47																								
	7 16.0-17.5	GC-GM		52	30	18																								
	8 17.5-20.0	GC-GM		60	25	15																								
S-4	1 0.0-2.5	SP-SM	"	9	87	5																								
	2 2.5-5.0	SP-SM	"	13	82	5																								
	3 5.0-8.0	SP-SM	"	7	88	5																								
S-5	1 0.0-2.5	Wood chips			20	1																								
	2 2.5-5.0	"	"		20	1																								
	3 5.0-7.5	"	"		20	1																								
	4 7.5-10.0	"	"		20	1																								
S-6	1 0.0-2.5	SP-SM	"		96	4																								
	2 2.5-5.0	SP-SM	"	1	94	5																								
	3 5.0-7.5	SC-SM	"	11	62	27																								
	4 7.5-10.0	SC-SM	"	25	45	30																								
	5 10.0-12.0	SC-SM	"	10	55	35																								
S-	:--2.0	SP	"	1	96	3																								
	2 2.0-5.0	SP	"	1	96	3																								
	3 5.0-7.5	SP	"	1	96	3																								
	4 7.5-10.0	SP	"	1	96	3																								
S-	0.0-2.5	SP	"		97	3																								
	5 2.5-5.0	SP	"		97	3																								

STANDARD FORM NO. 2086 (PREVIOUS EDITIONS MAY BE USED) (TRANSLUCENT)

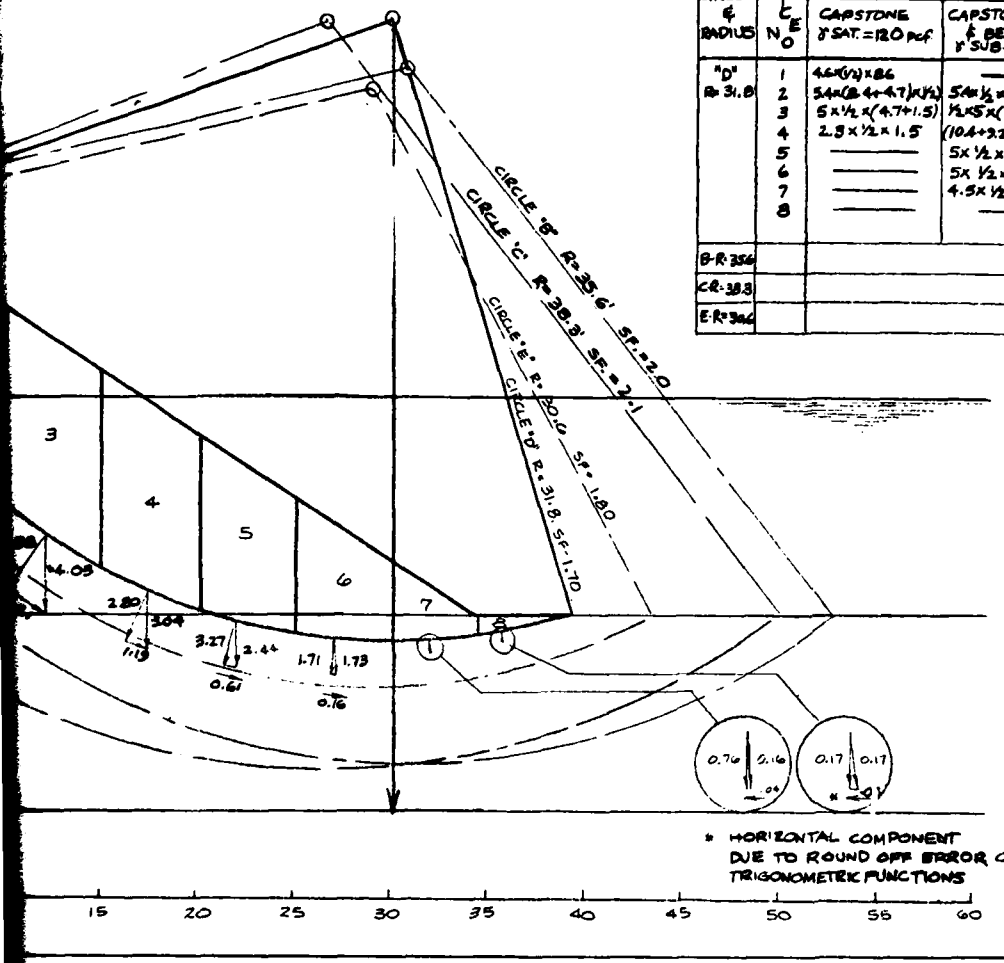
TC – Triaxial Compression, UC – Unconfined Compression, DS – Direct Shear, UU – Unconsolidated Undrained, CD – Consolidated Drained, CU – Consolidated Undrained, *Values at Pressure

Plate 28


590
585
580
575
570
565
560
555
550
ELEVATIONS
576.8 IGLD. = LWD
CAPSTONE
γ' SAT. 120 pcf
γ' SUB = 60 pcf
C = 0
Ø = 42°
CORE & BEDDING STONE
γ' = 60 pcf
C = 0
Ø = 42°
MEDIUM TO DENSE (SP-SM)
γ' = 60 pcf.
C = .200 ksf.
Ø = 30°
DENSE (SM) TO (SM-SC)
γ' = 76 pcf C = .360 KSF
Ø = 25°
1
2
3
4
1.26
2.02
2.38
3.56
5.16
3.38
4.09
2.80
3.04
3.27
1.13
40
35
30
25
20
15
10
5
0
5
10
15
20

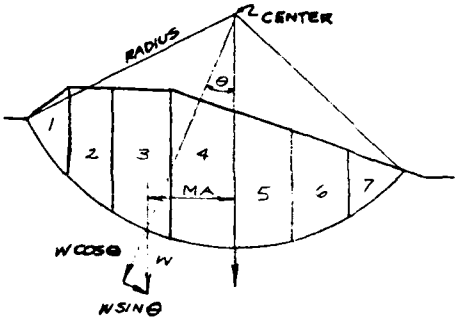
CIRCLE & RADIUS	SLICE NO.	AREA sq. ft. CAPSTONE γ SAT. = 120 pcf	AREA sq. ft. CAPSTONE CORE & BEDDING γ SUB = 60 pcf	AREA sq. ft. MEDIUM DENSE (SP-SM) γ' = 60 pcf	MOMENT ARM	MAT'R = SIN θ	COS θ	TANG WEIGHT (R CAPSTONE γ SAT. = 0.12 KCF	TANG WEIGHT (R CAPSTONE & BEDDIN γ SUB = 0.06 K
"D" R = 31.8	1	4.6×(½)×8.6	———	———	27.0	.85	.53	19.8	—
	2	5.4×(8.4+4.7)×(½)	5.4×½×5.6	———	22.8'	.72	.69	35.4	15.1
	3	5×½×(4.7+1.5)	½×5×(5.6+8.9)	———	17.5'	.55	.84	15.5	36.2
	4	2.3×½×1.5	(10.4+3.2)×½×5-2.3×½×	———	12.5'	.39	.92	1.7	47.9
	5	———	5×½×(9.2+6.1)	4.5×½×1	7.9'	.25	.97	—	38.3
	6	———	5×½×(6+8)	5×½×(1.0+1.5	2.9'	.09	.99	—	22.5
	7	———	4.5×½×3	4.5×½×(1.5+1.1)	1.7'	.06	.99	—	6.75
	8	———	———	5×½×1.1	5.8'	.18	.98		
B-R-35.6									
C-R-38.3									
E-R-39.6									

FAC



* HORIZONTAL COMPONENT DUE TO ROUND OFF ERROR OF TRIGONOMETRIC FUNCTIONS

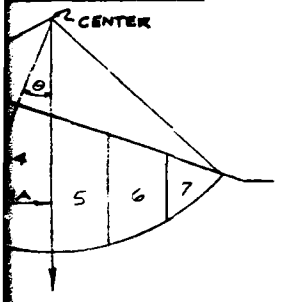
TYPICAL SECTION OF ROTATIONAL METHOD OF SLICES



SLICE NUMBER	MAP R = SIN θ	COS θ	TANGENTIAL FORCES — WEIGHT (KIPS): CAPSTONE γ SAT. = 0.12 KCF	CAPSTONE CORE & BEDDING γ SUB = 0.06 KCF	(SM-SP) γ SUB = 0.062 KCF	TOTAL WEIGHT (KIPS)	W SIN θ = DRIVING FORCE (KIPS)	W SIN θ = RESISTING FORCE (KIPS)	NORMAL FORCES — TOTAL WEIGHT (KIPS)	TAN Ø	W COS θ = Fn	Fn TAN Ø	C_{HES} (KIPS/FT)	ARC LENGTH (FT) H	CbL (KIPS)	SAFETY FACTOR
27.0	.85	.53	19.8	—	—	2.38	2.02	—	2.58	.90	1.26	1.14	—	—		
22.8	.72	.69	35.4	15.1	—	5.16	3.72	—	5.16	.90	3.56	3.20	—	—		
17.5	.55	.84	15.5	36.2	—	4.03	2.21	—	4.03	.90	3.38	3.04	—	—		
12.5	.39	.92	1.7	47.3	—	3.04	1.19	—	3.04	.90	2.80	2.52	—	—		
7.9	.25	.97	—	38.3	2.3	2.44	0.61	—	2.44	.577	2.37	1.37	.2	5	1.0	
2.9	.09	.99	—	22.5	6.25	1.73	0.16	—	1.73	.577	1.71	0.99	.2	5	1.0	
1.7	.06	.99	—	6.75	5.85	0.76		0.4	0.76	.577	0.75	0.43	.2	4.5	0.9	
5.8	.18	.98			2.8	0.17		0.4	0.17	.577	0.17	0.10	.2	5.2	1.04	
							9.91	0.8				12.79			3.94	1.70
							18.04	1.51				22.97			9.58	2.0
							20.61	1.73				28.84			10.04	2.1
							12.41	0.37				15.55			6.06	1.80

FACTOR OF SAFETY = $\frac{\Sigma Fn \tan\phi + cbL}{\Sigma TD - \Sigma TR} = \frac{12.79 + 3.94}{9.91 - 0.8} = \frac{16.73}{9.83} = 1.70$

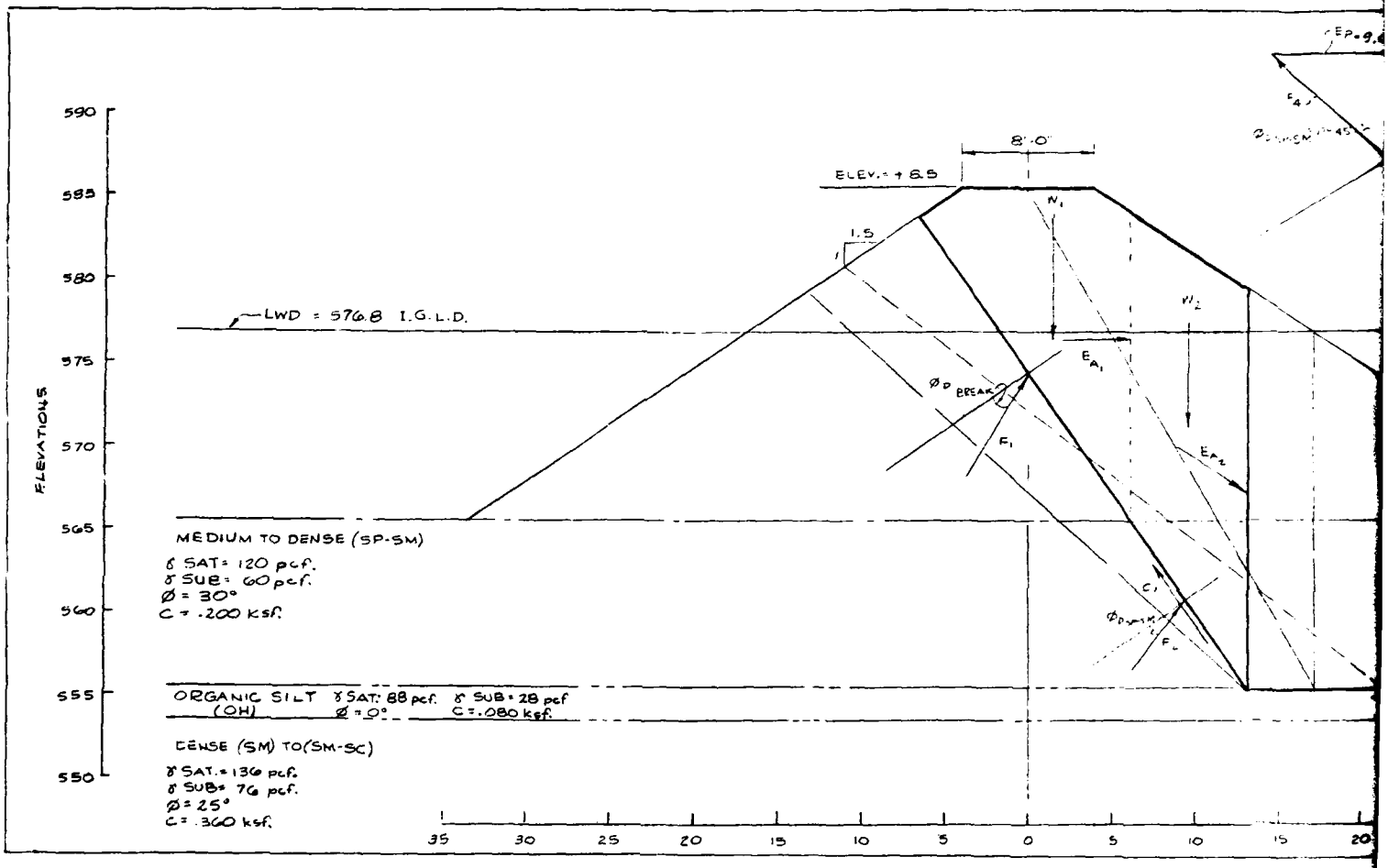
AL SECTION OF
METHOD OF SLICES

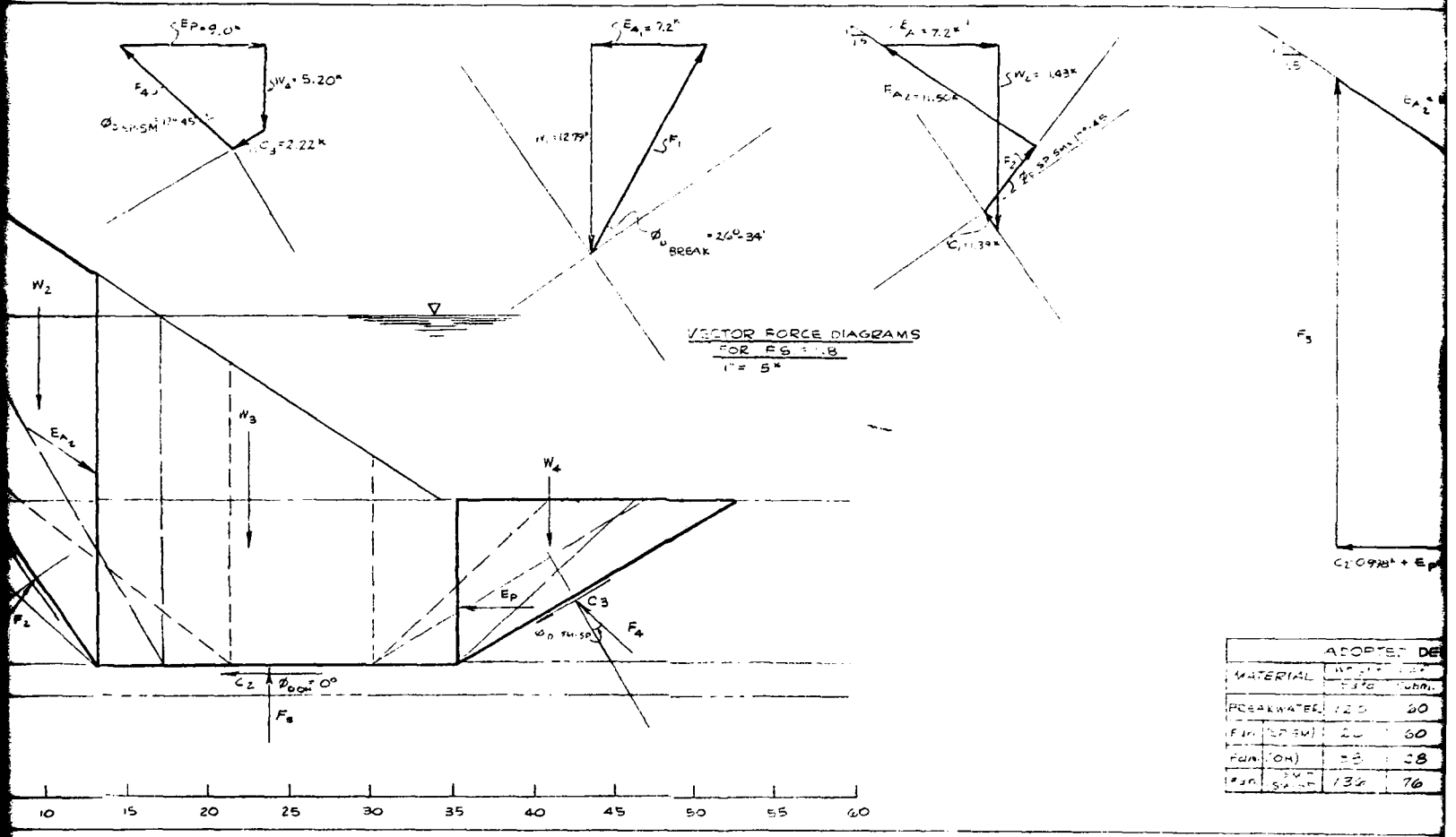


ELEVATIONS ARE IN FEET AND REFER TO (LWD) LOW WATER DATUM FOR LAKE MICHIGAN IS 576.8 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC, INTERNATIONAL GREAT LAKES DATUM (IGLD) 1955.

CEDAR RIVER HARBOR
MICHIGAN
ROTATIONAL METHOD OF SLICES
STABILITY ANALYSIS
OF BREAKWATER

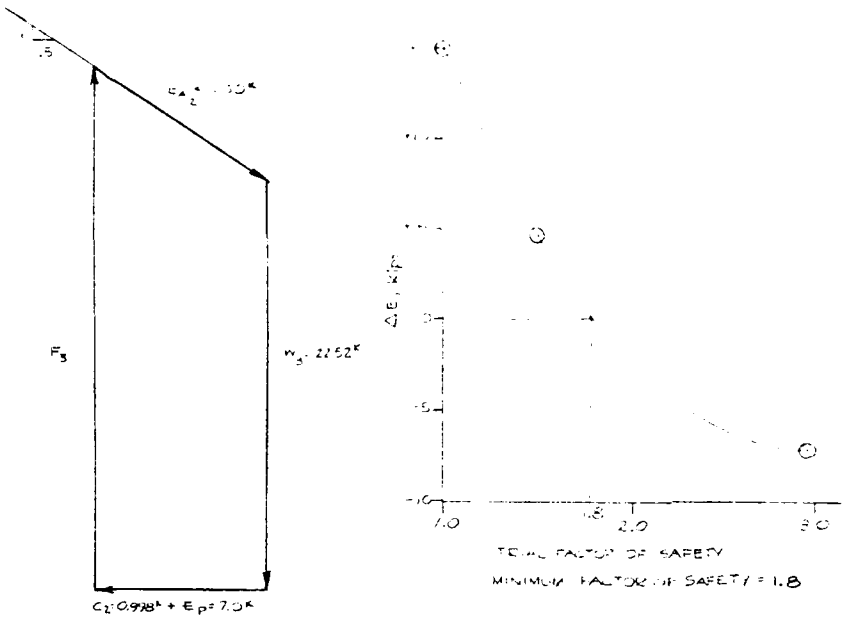
PLATE A-29


590
585
580
575
570
565
560
555
550
ELEVATIONS
8'-0"
ELEV. = + 6.5
1.5
1
LWD = 576.8 I.G.L.D.
N_1
N_2
E_{A_1}
E_{A_2}
$\phi_{D\ BREAK}$
F_1
C_1
F_2
MEDIUM TO DENSE (SP-SM)
δ SAT = 120 pcf.
δ SUB = 60 pcf.
Ø = 30°
C = .200 ksf.
ORGANIC SILT (OH)
δ SAT: 88 pcf.
δ SUB = 28 pcf
Ø = 0°
C = .080 ksf.
DENSE (SM) TO (SM-SC)
δ SAT. = 130 pcf.
δ SUB = 70 pcf.
Ø = 25°
C = .360 ksf.
35
30
25
20
15
10
5
0
5
10
15
20



VECTOR FORCE DIAGRAMS
FOR FS = 1.8
1" = 5K

	ADOPTED DE	
MATERIAL		
PEAK WATER	125	60
	20	60
	35	28
	135	76



ADOPTED DESIGN CRITERIA						
MATERIAL		WEIGHT		STRENGTH		
		Sat.	Subm.	ϕ	$\tan\phi$	C (psf)
BREAKWATER		120	60	42°	0.900	0
Fdn.	(SP-SM)	120	60	30°	0.577	300
Fdn.	(OH)	88	28	0°	0.000	80
Fdn.	(SM-SP, SM, SP)	136	76	25°	0.466	960

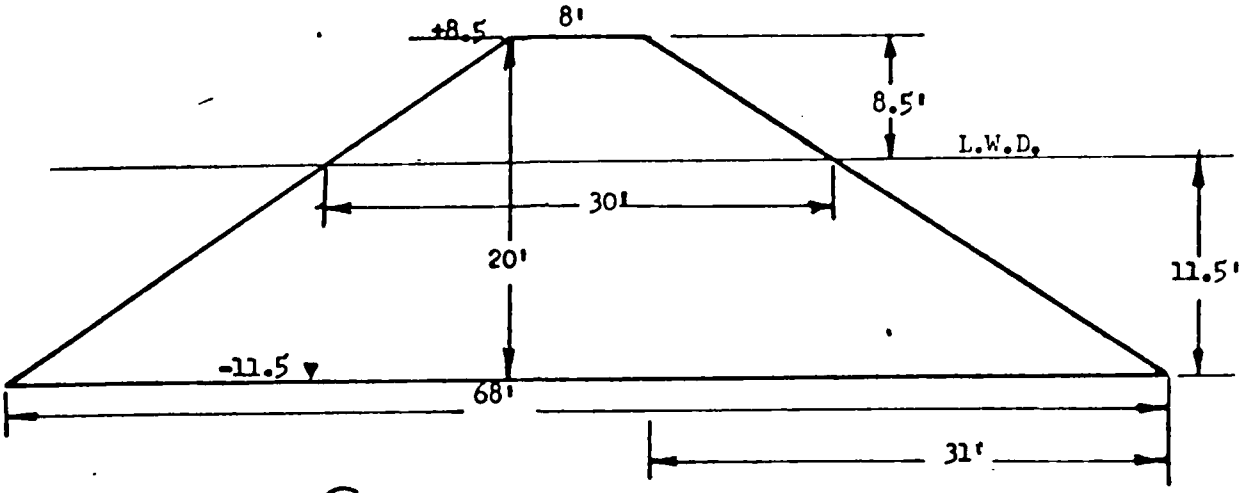
CEDAR RIVER HARBOR
MICHIGAN
WEDGE METHOD
STABILITY ANALYSIS
OF BREAKWATER

PLATE A-30

COMPUTATION SHEET		Page 1 of 6
NAME OF OFFICE: FOUNDATIONS & MATERIALS BRANCH	COMPUTATION: SETTLEMENT RUBBLE MOUND PIER	
SUBJECT: CEDAR RIVER HARBOR, MICHIGAN	SOURCE DATA: TYPICAL SECTION "A"	
COMPUTED BY: C.W.G.	CHECKED BY: C.W.G.	APPROVED BY:

STRESS CALCULATIONS

TYPICAL SECTION "A"



ASSUMED
- γ SAT. CAPSTONE = 120 pcf.
- γ SAT. CORE & BEDDING STONE = 120 pcf.
- γ SUB. CORE & BEDDING STONE = 60 pcf.

Wt. of Rubble Mound/ running ft. = 120 X (8+30) X $\frac{1}{2}$ X 8.5+60 X$\frac{1}{2}$ X (68+30) X11.5=

53,000 lbs/ft= 53.2 K/ft=26.6 T/ft

effective width = 8 + 2 X 0.4 X 31 = 32.8 ft

$$q \text{ (intensity)} = \frac{26.6 T/ft}{32.8} = 0.81 \text{ tsf}$$

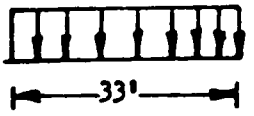


PLATE 31

COMPUTATION SHEET	DATE	PAGE 2 OF 6	FILE NUMBER
NAME OF OFFICE		COMPUTATION	
SUBJECT		SOURCE DATA	
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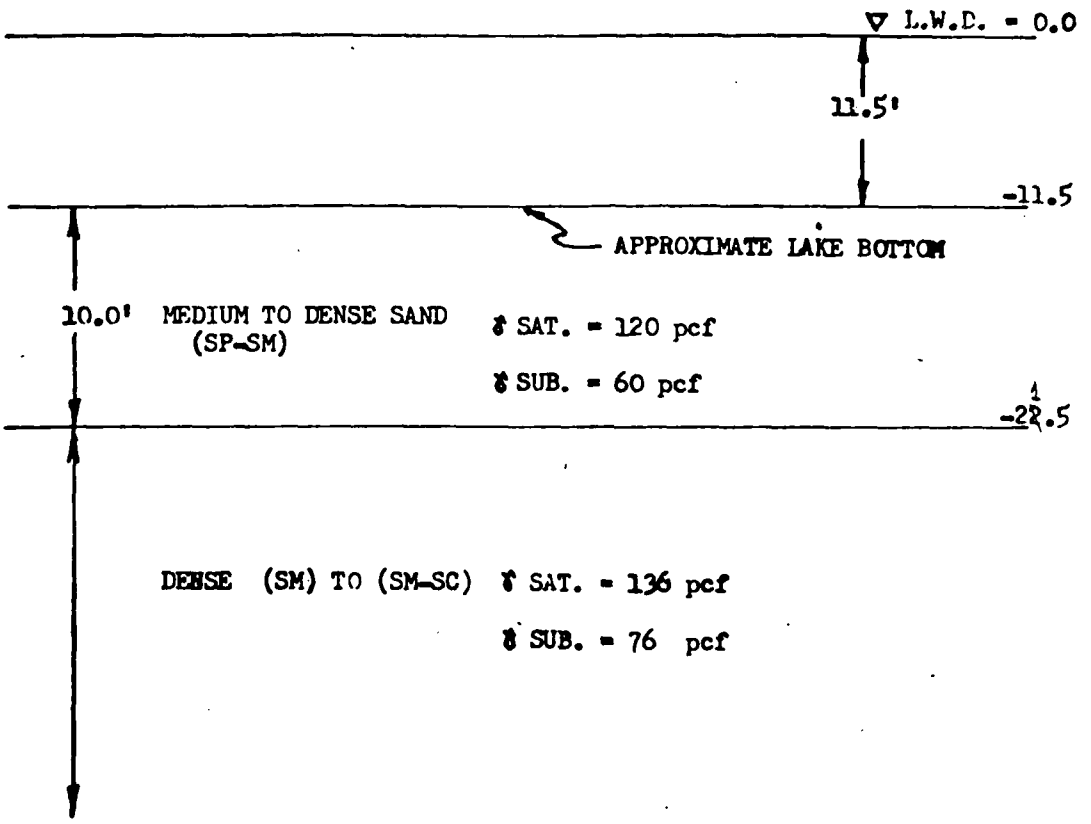
IDEALIZED SOIL PROFILE



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SUBJECT		SOURCE DATA	
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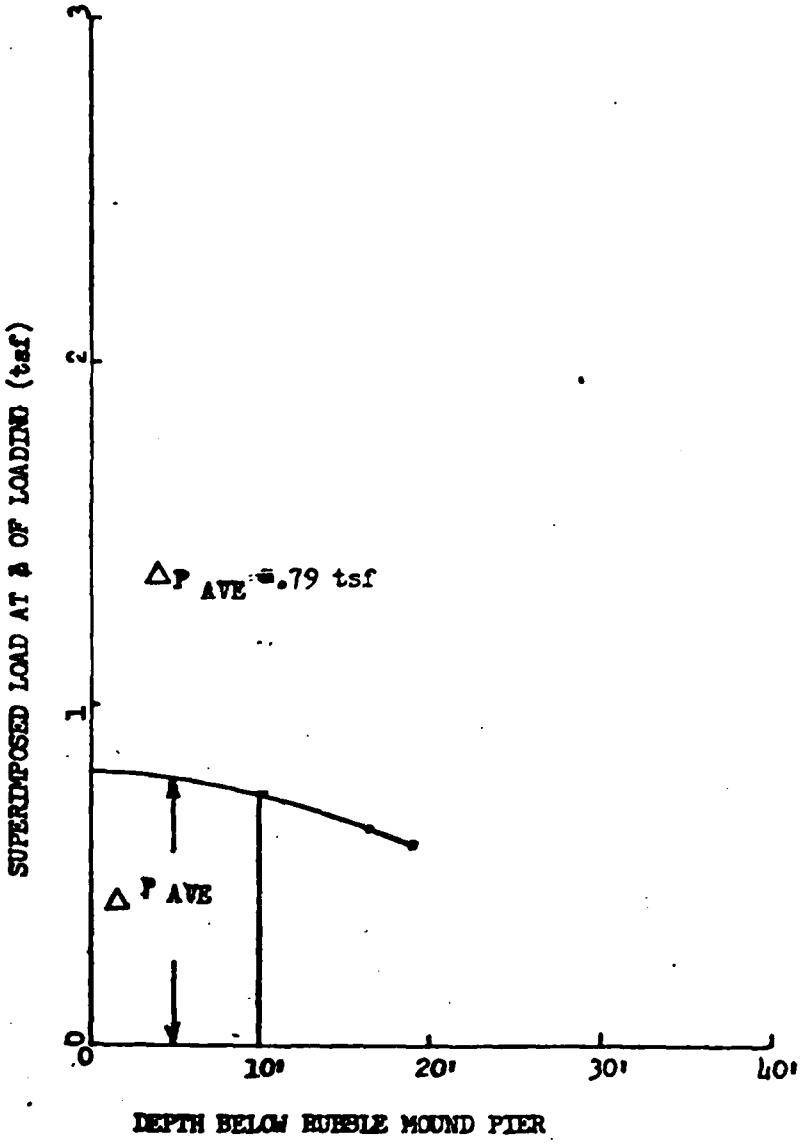

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NAME OF OFFICE		COMPUTATION	
SUBJECT		SOURCE DATA	
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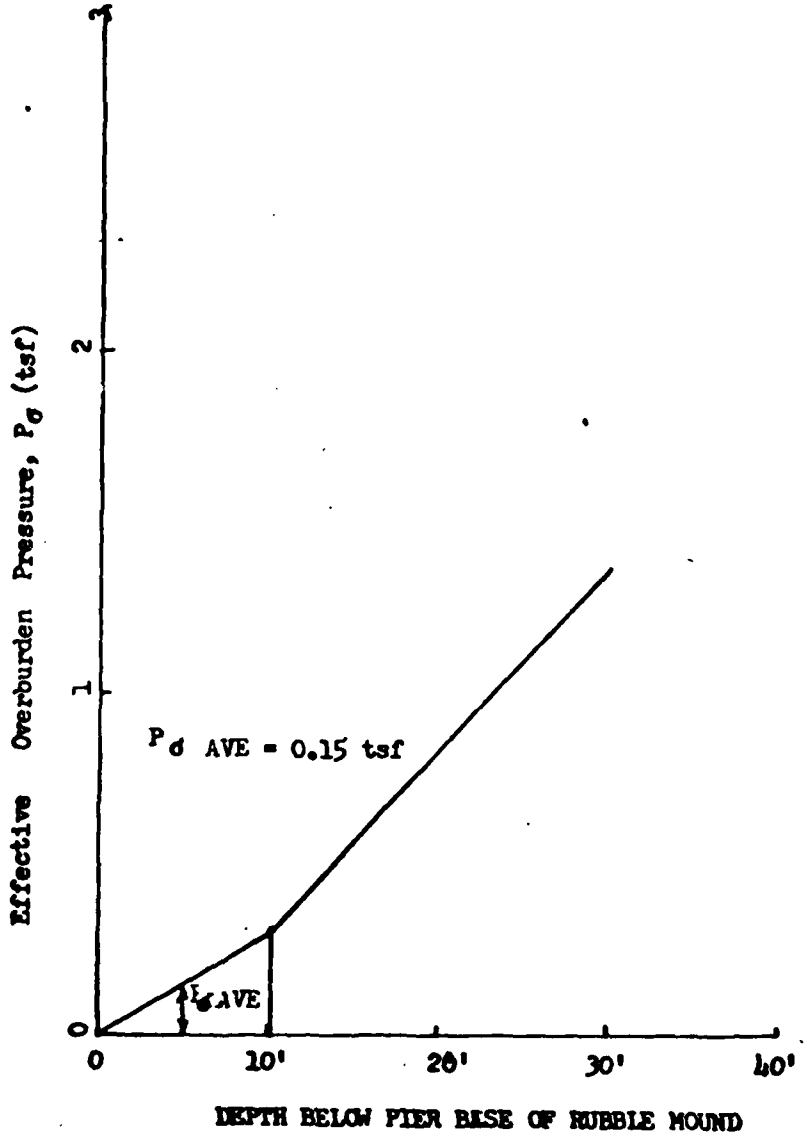

COMPUTATION SHEET	DATE	PAGE 5 OF 6	FILE NUMBER
NAME OF OFFICE	COMPUTATION		
SUBJECT	SOURCE DATA		
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CONTACT OR INTIAL SETTLEMENT OF MEDIUM TO DENSE (SP-SM) AND DENSE (SM) TO (SM-SC)

ASSUME $\begin{cases} E \text{ SAND MEDIUM TO DENSE} = 12{,}000 \text{ psi} = 173 \times 10^4 \text{ psf} \\ u = \text{POISSON RATIO} = 0.33 \end{cases}$

reference page 789 of Leonards Foundation Engineering
from Foundation Engineering by Leonards page 566

$$S_I = \frac{q\, b\, (1-u^2)\, I_p}{E}$$

WHERE q = LOAD INTENSITY psf

b = EFFECTIVE WIDTH OF IDEALIZED LOADING, ft.

E = MODULUS OF ELASTICITY OF THE SOIL

u = POISSON RATIO OF THE SOIL

I_p = THE INFLUENCE FACTOR

S_I = INTIAL OR CONTACT SETTLEMENT

$q = 0.81 \times 2000 = 1600$ psf

$b = 33$ ft. $\qquad E = 173 \times 10^4$ psf

$u = 0.33 \qquad I_p = 3.0$ for $\frac{L}{b} \rightarrow 10$ where L = length of structure

$$S_I = \frac{(1600)\,(33)\,(1 - 0.33^2)\,(3.0)}{173 \times 10^4} = .0815 \text{ ft.} = 0.98 \text{ inches} \cong 1 \text{ inch}$$

PLATE 35

COMPUTATION SHEET	DATE	PAGE 6 OF 6	FILE NUMBER
NAME OF OFFICE	COMPUTATION		
SUBJECT	SOURCE DATA		
COMPUTED BY	CHECKED BY	APPROVED BY	

CONSOLIDATION SETTLEMENT OF

MEDIUM TO DENSE (SP - SM)

ASSUME $\begin{cases} e_o \text{ AVE} = 0.500 \text{ (FROM LAB. DATA)} \\ C_c = 0.04 \text{ (REFERENCE TM 5-818-1, Page 16)} \end{cases}$

ASSUME CONSOLIDATION SETTLEMENT OF DENSE (SM) TO (SM-SC) MATERIAL IS NEGLIGIBLE

$$S_c = \frac{C_c}{1+e_o} \log \frac{(P_{\sigma\,AVE} + \Delta P_{AVE})_H}{P_{\sigma\,AVE}}$$

$H = 10'$

$\Delta P_{AVE} = 0.79$ tsf

$P_{\sigma\,AVE} = 0.15$ tsf

$$S_c = \frac{0.04}{1.50} \log \frac{0.94}{0.15} \times 10 = 0.212\text{ft} = 2.5 \text{ inches} \cong 3 \text{ inches}$$

TOTAL ESTIMATED SETTLEMENT OF RUBBLE MOUND PIER = 3 + 1 = 4 inches

PLATE 36

DCD Form 1 APR 63 | 14 Previous edition may be used until supply is exhausted.

Appendix B

HYDRAULIC ANALYSIS

APPENDIX B - HYDRAULIC APPENDIX
CEDAR RIVER HARBOR, MICHIGAN

TABLE OF CONTENTS

LIST OF TABLES

APPENDIX B - HYDRAULIC APPENDIX

GENERAL

1. This appendix contains data on lake levels, fetches, wind, waves refraction and littoral drift. From these data stone sizes for the rubble mound and wave forces are determined.

BAY LEVELS

2. AVERAGE LEVELS

The established low water datum for Green Bay and Lake Michigan is 576.8 feet (I.G.L.D.). The average level during the 118-year period 1860 to 1978 was 578.71 feet. The highest one month average of 581.94 feet occurred in June 1886 and the lowest of 575.35 feet in March 1964, a spread of 6.9 feet. The greatest annual fluctuation as shown by the highest and the lowest monthly means of any year was 2.23 feet, and the lowest annual fluctuation was 0.36 foot. Variations in the water level caused by seasonal changes in runoff supplied to the lake occur each year, with the low normally occurring during the winter months and the high during the summer.

3. TEMPORARY RISES

Superimposed on the long range and seasonal variations are fluctuations which may last several days. These are caused primarily by winds which drive the water forward in greater volume than that carried by the lower return currents, thus raising the elevation on the lee shore and lowering it on the weather shore. This effect is pronounced at the south ends of Lake Michigan and Green Bay. It is known that a temporary rise of 1.9 feet may recur about once each in 20 years at Sturgeon Bay.

4. DESIGN LEVEL

The 20 year lake level was calculated from a previous Flood Insurance Study for the Cedar River area. The study is for the Township of Cedarville, Menominee County, Michigan completed in January 1977. The design still water level used for design of the pier structures is taken as the 20 year annual mean level for Lake Michigan with a 20 year annual peak rise for Sturgeon Bay, Wisconsin superimposed upon it. The design still water level is then 580.6 feet + 1.9 feet = 582.5 feet IGLD or +5.7 ft. above low water datum.

EXPOSURE

5. FETCHES

The harbor is exposed to wave action generated by winds acting over fetches on Green Bay from the east northeast through east around to south. The islands in the Green Bay Passages prevent waves generated on Lake Michigan from reaching the harbor. Wave action from the south is limited by Chamber's Island and shoals. Table B-1 shows fetch lengths and depths over the fetches.

Table B-1 - Fetches and Depths

Direction	Fetch length, miles	Depths over fetches, feet
ENE	27	72
E	25	95
SE	17	118
S	22	126

6. DEPTHS

The depth at the proposed pierhead, shown by 1979 soundings, is 5 feet. The contours up to 60 foot depth are deflected southeasterly which may be due to sediment deposits from Cedar River or littoral drift from the north. U.S Lake Survey chart No. 14909 shows hydrography of the area to a scale of 1 to 80,000. Contours plotted at 6 foot intervals on this chart were used for construction of refraction diagrams.

7. WIND

The wind data used was from the Traverse City, Michigan weather station 1948 thru 1964. (Available records from Green Bay did not have durations, therefore, could not combine data for the two stations to average for Cedar River.) It was felt that the problems with the distance between the site and reporting station would be averaged with the long term record. The directions chosen for analysis are the south, southeast, east and east northeast. Table B-2 gives the wind and wave parameters used.

TABLE B-2 WIND DATA
TRAVERSE CITY FOR 1948 to 1970

Wind Direction	Wind Velocity @ Report Station (Knots)	Wind Velocity Over Lake (Knots)	Wind Duration (Hours)	Effective Fetch Statute Miles (F eff)	Significant Wave Height Feet (H)	Significant Wave Period Secs (T)
ENE (67.5°)	17	24.3	$\geq$ 24	27	5.0	4.9
Used 66°	22	31.4	3		6.1	5.3
for calc. of	26	37.1	1		4.4	4.7
eff fetch						
EAST (90°)	22	31.4	19	25	6.6	5.6
	24	34.3	8		7.4	5.9
	26	37.1	6		8.0	6.1
	31	44.3	1		5.6	4.9
S. E. (135)	17	24.3	15	17	4.2	4.5
	25	35.7	12		6.4	5.4
	27	38.6	4		7.2	5.7
	32	45.7	2		8.5	6.2
	38	54.3	3		10.3	6.8
	43	61.4	1		9.0	6.2

Wind Direction	Wind Velocity @ Report Station (Knots)	Wind Velocity Over Lake (Knots)	Wind Duration (Hours)	Effective Fetch Statute Miles (F eff)	Significant Wave Height Feet (H)	Significant Wave Period Secs (T)
SOUTH	20	28.6	$\geq$ 24	22	5.6	5.2
	24	34.3	14		7.0	5.8
	30	42.8	9		9.1	6.4
	32	45.7	7		9.8	6.7
	35	50.0	4		11.0	7.0

8. FORECASTS

The largest calculated significant wave heights and associated periods were used to calculate deep water conditions for each of the fetch directions. This check showed that the southeast and south fetches did not have deep water conditions. Shallow water wave generation calculations were then used to determine waves for each of these two fetches. Table B-3 shows the values obtained.

TABLE B-3 DEEP WATER CHARACTERISTICS

Wave Direction	Significant Height Feet H	Significant Period Secs T	Wave Length Feet Lo	Depth Deep Water Feet d	Condition Deep or Shallow Over Majority of Fetch
ENE (66°)	6.1	5.3	144	72	Deep
E (90°)	8.0	6.1	190	95	Deep
SE (135°)	10.3	6.8	237	118	Shallow
S (180°)	11.0	7.0	251	126	Shallow

Wave Direction	Wave Height	Frequency	Point On Structure	Runup, Ft.
ENE	4.5	Once/16 yr. Winter	LAKE END	5.6
			NEAR SHORE	5.1
E	7.5	Once/16 yr. Spring	LAKE END	8.3
			NEAR SHORE	7.6
SE	9.5	Once/16 yr. Winter	LAKE END	10.2
			NEAR SHORE	10.1
S	7.0	Once/16 yr. Spring	LAKE END	--
			NEAR SHORE	--

9. REFRACTION

For LWD lake level refraction diagrams were drawn for the waves in Table B-3 using the periods as indicated. They were carried to the shoreline. The refraction effects on the bay are more complex than shown by the diagrams due to interference by islands and shoals. This interference causes choppy conditions instead of the regular wave trains implied by the diagrams. The limited waves which can reach the harbor from directions west of south move nearly parallel to the shore and are heavily refracted so it appears reasonable to neglect their effect at the harbor. Such waves are the local chop type. The coefficients and direction of refracted waves and wave heights at the structure are shown in Table B-4.

TABLE B-4 REFRACTION COEFFICIENTS

Wave Direction	Deep Water Wave Height Feet	Significant Period Secs	Coefficient Refraction K_r	Coefficient Shoaling K_s	Wave Ht @ Structure
ENE (66°)	6.1	5.3	0.79	0.9184	4.5
E (90°)	8.0	6.1	0.98	0.9372	7.5
SE (135°)	10.3	6.8	0.95	0.9608	9.5
S (180°)	11.0	7.0	0.65	0.9682	7.0

10. DIFFRACTION

The waves approaching from the south will enter the breakwater approximately on a line with breakwater opening. Therefore, there will be little or no diffraction of the incoming waves. The waves approaching from the east-northeast will refract until the approach approximates the direction of the waves from the east. The calculations for diffraction used the technique outlined in "*Diffraction Diagrams For Directional Random Waves*," by Yoshima Goda, Tomotsuka Takoyama and Yasumasa Suzuki. The diffracted wave height at the harbor is 3.0 feet from the ENE and 6.0 feet from the east.

11. WAVE RUNUP

Wave runup values are indicated at the end of the new pier (10 foot depth) and near the shoreline (4 foot depth). Runup values for the south wave are nonexistent since the waves are parallel to the structure.

No model study was made to verify the effect of reducing the length of the east pier, which was shortened to allow more of the littoral drift to pass the mouth of the Cedar River, and to reduce construction costs.

Because of pier orientation, waves of somewhat large amplitude originating from the southeast, would normally be expected to propagate upstream into the vicinity of the anchorage area. Analysis of these physical characteristics of the piers using the methods described by de St. Issacson* for parallel rubblemound pier-type structures shows that a considerable attenuation of incoming waves is achieved by the coarse surface texture of rubblemound type construction (for the proposed piers).

*Journal of Waterways, Port, Coastal and Ocean Division, ASCE, Wave Dampening Due to Rubblemound Breakwaters, Michael de St. Isaacson, November 1978, pp. 391-403.

Application of this method to the 9.5 foot wave from the southeast (SE), yields a considerable reduction of wave height for a parallel pier structure of length 220 feet. The design wave after passage through the pier structures would have a height of less than 3.0 feet prior to advancement on the upstream anchorage area, where wave heights of one foot or less are expected.

LITTORAL DRIFT

12. A soil map for the county was last compiled in 1925. However, the soil survey is in the process of being updated. A field agent working on this project has indicated that this map is still a good representation of existing soil conditions. The data indicates fine sand, fine sandy loams and some organic soils just behind the shoreline. The shoreline soils consist of coastal sands and fill material. Aerial photographs from 1953, 1964 and 1976 indicate very little change in the shoreline. There is a fluctuation in shoreline position, but it appears that this is due almost entirely to lake level fluctuations.

The Michigan Department of Natural Resources, using sets of aerial photography from the years 1938 and 1976 has made measurements to determine high risk erosion areas. Within this study only one area in the vicinity of Cedar River has been identified as having appreciable erosion. This section is approximately three quarters of a mile south of Cedar River. The long term recession rate for this area has been calculated from measurements on aerial photographs as approximately one foot per year.

The LEO program had a reporting station at Wells State Park, which is located approximately a mile and a half south from Cedar River. The data collected in this program, included wind direction and velocity, breaker height and beach profiles and was collected from June 1972 to November 1976. The following data on yearly, net volume of littoral drift was calculated.

Dates	Net Littoral Drift
6-12-72 to 12-1-72	29,027 cubic yards to the north
4-10-73 to 12-3-73	20,619 cubic yards to the south
5-1-75 to 11-24-75	138,931 cubic yards to the north
5-20-76 to 11-12-76	52,378 cubic yards to the north

However, because of the short term record it is not possible to make a definite judgement on the net littoral direction. In addition, because of the limited amount of data and the assumptions inherent in the equations, the transport rates should only be used as indicators of the magnitude. Dredging records from around the Green Bay harbor indicated that the predominant littoral drift direction was from the north to the south. It is not indicated what length of record was available for the analysis, but it is assumed the LEO data is representative of conditions.

The section of shoreline north and south of the Cedar River appears to be in an equilibrium state as indicated in aerial photographs. Deadmans Point to the north of Cedar River is a natural barrier to much of the littoral movement. Therefore, any major impacts of the structure will be limited to the north by the Point and the associated offshore topography. Thus the structure should have minimal effect on the littoral transport near Cedar River.

Design of the parallel pier entrance structures, according to present theory, resulted in a reduction of total length with concomitant reduced construction costs. Because a model study was not undertaken to quantify the relationship between littoral drift, wave heights (within the harbor), and pier length, extensions to the proposed shortened rubblemound piers (to adjust pier length to that originally authorized) can be deferred at this time, to judge the validity of assumptions used in the design of the proposed plan of improvement.

Appendix C

EXISTING STRUCTURE

SUPPLEMENT NO. 1

REVISIONS TO APPENDIX C

DESCRIPTION AND CONDITION OF

EXISTING STRUCTURES

CEDAR RIVER HARBOR, MICHIGAN

TABLE OF CONTENTS

SUPPLEMENT NO. 1
REVISIONS TO APPENDIX C
DESCRIPTION AND CONDITION OF
EXISTING STRUCTURES
CEDAR RIVER HARBOR, MICHIGAN

General

The Cedar River Harbor project consists of an entrance channel from Green Bay to the mouth of Cedar River and two parallel entrance piers.

Summary

A summary of the description and condition of the existing structures based on an inspection of 27 July 1961 is given in the following tabulation.

Structure	Description	Condition
East Pier	Timber piles and timber sheeting on the lake side, closely driven timber piles on the channel side enclosing stone fill. Lakeside and channel side piles held together by 1-1/2" tie rods.	Tops of timber piles and timber sheeting deteriorated. Exterior wales missing. Tie rods bent. Portion of pier washed out at Station 3 + 00.
West Pier	Same as East Pier.	Tops of timber piles and timber sheeting deteriorated. Exterior timber wales missing. Tie rods bent. Portion of pier washed out at Station 7 + 00.

Subsequent inspections made on 21 February 1979 and 2 August 1979, indicated that the west pier had suffered severe deterioration probably due to high lake levels experienced during the late 60's and early 70's. This deterioration requires that this 230 foot rubblemound pier section be rehabilitated, including the pierhead section protecting the existing navigational light.

Appendix D

COST ESTIMATE

SUPPLEMENT NO. 1

REVISIONS TO APPENDIX D

DETAIL OF COST ESTIMATE

CEDAR RIVER HARBOR, MICHIGAN

The estimated first costs for the proposed project are based on August, 1979 prices and are as follows:

Item	Unit	Unit Price	Quantity	Cost
Bedding Stone (1 Lb to 70 Lb)	Ton	$ 16	4,200	$ 67,200
Core Stone (600 Lb to 1750 Lb)	Ton	22	7,770	170,900
Cover Stone (2.25 Ton to 4.5 Ton)	Ton	27	9,700	261,900
Cover Stone (3.25 Ton to 6.25 Ton)	Ton	29	1,700	49,300
Light Base: Concrete	CY	150	8	1,200
Piling (HP 8 x 36)	LF	21	100	2,100
Grout Top of Pier and Pierhead	CY	100	26	2,600
Dredging	CY	5	40,000	200,000
Remove Timber Piles	EA	100	113	11,300
Remove Existing Stone	Ton	10	3,300	33,000
Fisherman's Walkway	LF	45	1,105	49,700
Subtotal				$ 849,200
Contingencies 15%				127,400
Total Construction				$ 976,600
Engineering and Design				215,000
Supervision and Administration				83,000
Sub-total				$1,274,600
Aids to Navigation				16,700
Right-of-Way				15,000
TOTAL PROJECT COST				$1,306,300

CEDAR RIVER
COST ESTIMATE
EAST - WEST PIERS

	EAST PIER				WEST PIER			
	Unit	Unit Price	Quantity	Cost	Unit	Unit Price	Quantity	Cost
Bedding Stone:	Ton	$16	3350	53,600	Ton	$16	850	$13,600
Core Stone:	Ton	22	6120	134,600	Ton	22	1650	36,300
Cover Stone:	Ton	27	7650	206,550	Ton	27	2050	55,350
	Ton	29	1350	39,150	Ton	29	350	10,150
Fisherman Walkway	L.F.	45	875	39,350	L.F.	45	230	10,350
Remove Timber Piles	Each	100	113	11,300	-	-	-	-
Remove Existing Stone	Ton	10	3300	33,000	-	-	-	-
Grout Top of Pier & Pierhead	Each	-	-	2,050	-	-	-	550
Light Base	Each	-	-	1,650	-	-	-	1,650
Subtotal				$521,250				$127,950

Total East + West = $649,200

Appendix E

LOCAL COORDINATION

APPENDIX E
Letters of Local Cooperation

STATE OF MICHIGAN

GEORGE ROMNEY, Governor

DEPARTMENT OF CONSERVATION

RALPH A. MAC MULLAN, Director

January 26, 1968

Serial No. 98-68
File No. Men-Cr

B. A. Fisher, Chief
Real Estate Division
Chicago District, Corps of Engineers
219 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Fisher:

Reference is made to your letter of January 23, 1968, enclosing a Resolution whereby the Waterways Commission grants assurances to the United States for the Cedar River Harbor project.

Before submitting the Resolution to the Waterways Commission for action, it is necessary to obtain some information relative to the probable date of fulfillment of these assurances. We must seek a legislative appropriation of the necessary funds and this involves quite a bit of time under ordinary circumstances, so that the greater the lead time the better.

Therefore, I would appreciate being advised of the probable date the cash contribution would be required of us and the probable date that real estate interests would have to be in hand.

Receipt of this information will assist me in presenting this Resolution to the Commission for action.

Sincerely yours,

Keith Wilson
Director

KW:cc

April 23, 1968

Serial No. 494-68
File No. MEN-CR

B. A. Fisher
Chief, Real Estate Division
Chicago District, Corps of Engineers
219 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Fisher:

Reference is made to your letter of January 23, 1968, my letter of January 26, 1968, and our telephone conversation of April 10, 1968, on local assurances for the Cedar River Harbor-of-Refuge, Michigan.

Enclosed are an original and two copies of a Resolution adopted by the Waterways Commission on April 17, 1968, extending its assurances to the United States for the subject project. Upon acceptance thereof, it is requested that one copy of these assurances indicating their acceptance be returned to this office for our files.

I am still awaiting submission of the Sima spoil disposal and channel easements for the New Buffalo project.

Sincerely,

Keith Wilson
Director

KW:efg
Enclosures

RESOLUTION AUTHORIZING ASSURANCE OF LOCAL COOPERATION

CEDAR RIVER HARBOR, MICHIGAN

WHEREAS, Congress, by the River and Harbor Act of 1965, approved October 27, 1965 (Public Law 89-298), authorized certain improvements of Cedar River Harbor, Michigan, subject to certain conditions of local cooperation in accordance with the report of the Chief of Engineers contained in House Document No. 248, 89th Congress, 1st Session; and

WHEREAS, the said project will be a public improvement for the benefit of and in the interest of the people of the State of Michigan; and

WHEREAS, the Waterways Commission, a Division of the Department of Conservation, an agency of the State of Michigan, hereinafter referred to as the "Commission", and is empowered by the laws of that State to enter into agreements with agencies of the United States whereby the State undertakes to participate with the Federal Government in the accomplishment of such projects; and

WHEREAS, the Commission is willing to undertake and to satisfy the prescribed conditions of local cooperation and has the legal authority and financial ability to do so and to give its assurances accordingly to the United States,

NOW, THEREFORE, BE IT RESOLVED, that the Commission does hereby grant and convey its assurances to the United States that it will:

a. Contribute in cash 15 percent of the first cost of the new navigation facilities and 50 percent of the first cost of structural modifications necessary to provide for a sport fishing walkway on top of the new east pier, the total of such contributions being presently estimated at $141,000.00, to be paid in a lump sum prior to initiation of construction, subject to final adjustment after actual costs have been determined;

b. Provide without cost to the United States all lands, easements, and right-of-way required for the construction and subsequent maintenance of the project and for aids to navigation upon the request of the Chief of Engineers, including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil; and necessary retaining dikes, bulkheads, and embankments therefor or the cost of such retaining works;

c. Hold and save the United States free from damages due to the construction works and maintenance of the project;

d. Provide and maintain without cost to the United States necessary mooring facilities and utilities, including an adequate public landing or wharf with provision for the sale of motor fuel, lubricants, and potable water, and a parking lot with adequate sanitary facilities, available to all on equal terms and including the dredging of berthing areas to depths commensurate with the related project depths; and

e. Reserve anchorage spaces and mooring facilities adequate for the accomodation of transient craft.

BE IT FURTHER RESOLVED, that three certified copies of this Resolution be forwarded to the District Engineer, U. S. Army Engineer District, Chicago, Corps of Engineers, as the document of assurance of the Commission evidencing its agreement to participate with the United States to accomplish the project in accordance with the provisions and conditions of the aforesaid authorization Act of Congress and the applicable rules and statutes of the State of Michigan.

Certified to be a true copy of a Resolution adopted at a duly held meeting of the Waterways Commission on the 17th day of April 1968, at ~~Detroit~~ Lansing, Michigan.

WATERWAYS COMMISSION, a Division of the Dept. of Conservation, an agency for the State of Michigan

Keith Wilson

KEITH WILSON, DIRECTOR
Division of Waterways

ACCEPTANCE OF ASSURANCES

The assurances contained in the foregoing Resolution of the Waterways Commission for the improvement of the Cedar River Harbor, Michigan project are hereby accepted for and on behalf of the United States.

Date: _____

EDWARD E. BENNETT
Colonel, Corps of Engineers
District Engineer

WILLIAM G MILLIKEN, Governor
DEPARTMENT OF NATURAL RESOURCES
HOWARD A TANNER, Director

P O Box [illegible]
Lansing, Michigan [illegible]

July 17, 1979

Serial No. 2213-79
File No. MEN-CR

Colonel Melvyn D. Remus
District Engineer, Detroit District
U.S. Army, Corps of Engineers
P.O. Box 1027
Detroit, Michigan 48231

Dear Colonel Remus:

This refers to your letter to Director Tanner dated May 8, 1979, and to Mr. L.N. Witte's letter to you dated May 30, 1979, regarding redesign of the proposed Cedar River Harbor-of-Refuge and the reconfirmation of local assurances.

Mr. Witte's letter approved the proposed redesign. The purpose of this letter is to advise you of recent action on the reconfirmation. At its meeting held May 31, 1979, the Waterways Commission:

> RESOLVED, that it does hereby indicate its present willingness and ability to consider the issuance of assurances for the modified Cedar River Harbor-of-Refuge project.

This statement was confirmed by the Natural Resources Commission at its meeting held July 12-13, 1979. With this action, the State stands ready to cooperate with your office in this project.

Sincerely,

Keith Wilson, Chief
Waterways Division

KW:efg
cc: L. Witte

MICHIGAN
THE GREAT LAKE STATE

CEDAR RIVER, MICHIGAN
SMALL BOAT HARBOR
PROPOSED LOCAL COOPERATION
AUTHORIZED PLAN

GENERAL REQUIREMENTS

To assure full public use of the Federal improvement for maximum benefit, local interests should be required to provide an adequate public landing with provisions for the sale of motor fuel, lubricants, and potable water, available to all on equal terms. They should provide and maintain, without cost to the United States, enough stalls, slips, or mooring facilities to insure efficient use of the harbor frontage, and should provide police and fire protection for transient and local boats. Local interests should be required to agree to hold and save the United States free from damages that may result from construction and maintenance of the improvement. They should also provide without cost to the United States all lands, easements, and rights-of-way for the construction and maintenance of the project when and as required.

CASH CONTRIBUTION

The benefits to be derived from the improvements for general navigation are 85 percent general and 15 percent local in nature while benefits from the sport fishing facilities are equally general and local. It is considered that local interests should bear a share of the project cost, exclusive of aids to navigation commensurate with that portion of benefits that are local in nature. Local interests therefore should be required to make a cash contribution of 15 percent of the actual cost of the general navigation facilities and 50 percent of the first cost of sport fishing facilities. This total cash contribution is presently estimated at $121,000,* based on April 1964 price levels. This estimate is for information only and will be adjusted to actual costs when construction is completed.

ASSURANCES

Local and state officials have indicated a willingness to meet the above-proposed requirements of local cooperation. The Michigan State Waterways Commission, on being informed of the general features of the proposed plan of improvement and the required local cooperation, stated that it would provide the cash contribution and would coordinate local efforts to meet other cooperation requirements. It is the opinion of the District Engineer that the responsible authorities are able to meet the proposed requirements of local cooperation, and will do so when and as required.

* $391,000 updated to January 1980 price levels.
$232,230 for revised recommended plan.

FEDERAL ENERGY REGULATORY COMMISSION
CHICAGO REGIONAL OFFICE
230 SOUTH DEARBORN STREET, ROOM 3130
CHICAGO, ILLINOIS 60604

In reply refer to:
OEPR-CH-RB

May 20, 1980

Mr. Abram Nicholson
Chief, Environmental Resources Branch
U.S. Army Engineer District, Detroit
P.O. Box 1027
Detroit, MI 48231

Your Reference: NCEED-ER

Dear Mr. Nicholson:

This is in response to Mr. Phil McCallister's April 29, 1980 letter inviting our review and comments on the Draft Environmental Impact Statement and the revisions to the General Design Memorandum for the Recreational Boat Harbor at Cedar River, Michigan.

Comments of this office are made in accordance with the National Environmental Policy Act of 1969 and the August 1, 1973 Guidelines of the Council on Environmental Quality. Our review of the Draft Environmental Impact Statement is to determine the effect on matters concerning the Federal Energy Regulatory Commission's responsibilities. Such responsibilities stem from the Federal Power Act and the Natural Gas Act and relate to the licensing of non-Federal hydroelectric projects and associated transmission lines; participation in planning and development of Federal hydroelectric projects; certification for construction and operation of natural gas pipeline facilities, defined to include both interstate pipeline and terminal facilities; and the permission and approval required for the abandonment of natural gas pipeline facilities.

Because the above-noted proposed development would not pose a major obstacle to the construction or operation of such facilities and because the Draft does not indicate that existing natural gas or hydroelectric developments would be adversely affected, we have no specific comments.

These comments are of this office and therefore do not necessarily represent the views of the Federal Energy Regulatory Commission.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL RESEARCH LABORATORIES
Great Lakes Environmental Research Laboratory
2300 Washtenaw Avenue
Ann Arbor, MI 48104

June 3, 1980

TO: PP/EC - Joyce M. Wood

FROM: RD/RF24 - Eugene J. Aubert

SUBJECT: DEIS 8005.03 Recreational Boat Harbor; Cedar River, Michigan (Supplement No. 1)

The subject DEIS prepared by the Corps of Engineers, Detroit District, on restoration of recreational boat harbor at Cedar River, Lake Michigan has been reviewed and comments herewith submitted.

Restoration of Cedar River Harbor piers and deepening of channel for small craft navigation will increase boat traffic and will have a negative impact on water quality. It is estimated that most of the impact will be limited to the harbor area and the long-term effect on Green Bay environment will remain minor. Wider and deeper entrance channel will allow larger waves to move into the harbor area.

Impact Statement indicates that the section of shoreline north and south of the Cedar River appears to be in an equilibrium state as indicated in aerial photographs (page B-8). Therefore, the net volume of littoral drift south of the river calculated as 138,931 cubic yards in 1975 is not realistic. Data on water level changes in Green Bay and Lake Michigan given on pages B-1 and G-10 require verification and coordination.

Rec'd 6/6/80 PP/EC

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
ATLANTA, GEORGIA 30333

June 4, 1980

U.S. Army Engineer District, Detroit
Attn: Chief, Environmental Resources Branch
P.O. Box 1027
Detroit, Michigan 48231

Dear Sir:

We have reviewed the Revisions to General Design Memorandum No. 1 and Draft Environmental Impact Statement (EIS) for the Recreational Boat Harbor, Cedar River, Michigan. We are responding on behalf of the Public Health Service.

We anticipate no adverse health impact resulting from the improvements described. However, we suggest the final EIS briefly address the following issues mentioned in the General Design Memorandum.

Reference is made on page 18 to provision and maintenance of necessary mooring facilities and utilities, including public landings or wharfs, with provision for potable water and for the sale of motor fuel, lubricants, and a parking lot with adequate sanitary facilities. The final EIS should expound upon these anticipated facilities, identifying type of water treatment, restroom and waste disposal facilities, safety around the fueling stations, and potential impacts regarding these facilities.

We appreciate the opportunity of reviewing this document. Please send us a copy of the final statement when it becomes available.

Sincerely yours,

Frank S. Lisella, Ph.D.
Chief, Environmental Affairs Group
Environmental Health Services Division
Bureau of State Services

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md. 20852

JUN 6 1980

OA/C52x6:JLR

Rec'd 6/9/80 PP/EC

TO: PP/EC - Joyce M. Wood

FROM: OA/C5 - Robert B. Rollins

SUBJECT: DEIS #8005.03 - Recreational Boat Harbor; Cedar River, Michigan (Supplement No. 1)

The subject statement has been reviewed within the areas of the National Ocean Survey's (NOS) responsibility and expertise, and in terms of the impact of the proposed action on NOS activities and projects.

The National Ocean Survey found Appendix B - Hydraulic Analysis to be extremely thorough, accurate, and more than adequate for the proposed project.

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Productivity, Technology, and Innovation
Washington, D.C. 20230
(202) 377-4335

June 20, 1980

U. S. Army Engineer District, Detroit
ATTN: Chief, Environmental Resources Branch
Post Office Box 1027
Detroit, Michigan 48231

Gentlemen:

This is in reference to your draft environmental impact statement entitled, "Recreational Boat Harbor, Cedar River, Michigan." The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving eight copies of the final environmental impact statement.

Sincerely,

John B. Cox, for

Bruce R. Barrett
Acting Director
Office of Environmental Affairs

Enclosures Memos from: Mr. Robert B. Rollins
National Ocean Survey - NOAA

Mr. Eugene J. Aubert
Environmental Research Laboratories - NOAA

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 5
18209 DIXIE HIGHWAY
HOMEWOOD, ILLINOIS 60430

June 17, 1980

IN REPLY REFER TO: HED-05

U.S. Army Engineer District, Detroit
P. O. Box 1027
Detroit, Michigan 48231

ATTN: Chief, Environmental Resources Branch

Gentlemen:

Supplement No. 1 to the General Design Memorandum and Draft Environmental Impact Statement for the Recreational Boat Harbor at Cedar River, Michigan has been reviewed and we have no comments to offer on the statement. The proposed action will not adversely affect the existing Federal-aid routes in the area.

Sincerely yours,

Donald E. Trull
Regional Administrator

W G Emrich

By:
W. G. Emrich, Director
Office of Environment and Design

United States Department of the Interior

OFFICE OF THE SECRETARY
NORTH CENTRAL REGION
175 WEST JACKSON BOULEVARD
CHICAGO, ILLINOIS 60604

ER 80/439

June 23, 1980

Colonel Robert Vermillion
District Engineer
U.S. Army Engineer District
Detroit
P.O. Box 1027
Detroit, Michigan 48231

Dear Colonel Vermillion:

We have reviewed the revisions to General Design Memorandum No. 1 and the Draft Environmental Statement for the Recreational Boat Harbor at Cedar River, Menominee County, Michigan (ER 80/439).

The following comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et. seq.) and in compliance with the intent of the National Environmental Policy Act of 1969.

Boating activity can be expected to increase (in the Cedar River area) as a result of improved harbor and channel conditions, so the necessity for emergency services could also be expected to increase. The statement should discuss boaters' safety relative to increased activity, the extent to which current emergency services are available, and whether projected needs can be met. Information such as emergency service locations, types of services provided, and estimates of "on-site arrival times" should be given.

The Heritage Conservation and Recreation Service has provided Land and Water Conservation Fund (LWCF) assistance for J. W. Wells State Park. The assisted area is located immediately to the west of the proposed project but would appear not to be adversely affected. However, should land from the site be converted to other than public outdoor recreation uses, a Section 6(f) conflict would result. Section 6(f) of the Land and Water Conservation Fund Act states:

"No property acquired or developed with assistance under this section shall, without the approval of the Secretary, be converted to other than public outdoor recreation uses. The Secretary shall approve such conversion only if he finds it to be in accord with the then existing comprehensive statewide outdoor recreation plan and only upon such conditions as he deems necessary to assure the substitution of other recreation properties of at least equal fair market value and of reasonably equivalent usefulness and location."

With regard to possible 6(f) conflicts, the State Liaison Officer responsible for administration of the LWCF program in the State of Michigan is Mr. O. J. Scherschligt, Deputy Director, Department of Natural Resources, Box 30028, Lansing, Michigan 48909.

No significant adverse effects on fish and wildlife resources or their habitats are expected to result from the presently proposed work.

Sincerely yours,

Franklin Thomas

Regional Environmental Officer

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

REPLY TO ATTENTION OF:

Colonel Robert V. Vermillion
District Engineer
U.S. Army Engineer District, Detroit
P.O. Box 1027
Detroit, Michigan 48231

24 JUN 1980

RE: 80-022-133
D-COE-F32066-MI

Dear Colonel Vermillion:

We have completed our review of the Draft Environmental Impact Statement (EIS) and General Design Memorandum on the proposed Recreational Boat Harbor at Cedar River, Michigan. It is our understanding that the authorized project consists of pier construction, entrance and inner channel dredging, turning basin dredging, removal of an old pier, and shoreline enhancement using clean dredged material. Alternatives to the project consist of the no-action alternative and alternative designs for the pier.

Based on the information provided in the documents mentioned above, we believe the proposed action and its alternatives will have only minor adverse effects on the environment. The proposed action (Alternative 2 - 875 ft. straight pier) appears to maximize navigational benefits without significantly impacting the surrounding environment; thus, we have no objections to the proposed action.

Since we have no specific comments to offer on the proposed activities, we are classifying the Draft EIS as LO-1. This means we lack objections to the environmental impacts associated with the project, and the environmental statement adequately identifies these impacts. In accordance with U.S. Environmental Protection Agency procedures, our classification of this project will be published in the Federal Register.

Thank you for the opportunity to review and comment on the Draft EIS. Upon issuance of the Final EIS, please forward 3 copies for our review. If there are any questions concerning our review of this project, please contact Mr. James Hooper of my staff at 312/886-6694.

Sincerely yours,

Barbara J. Taylor

Barbara J. Taylor, Chief
Environmental Impact Review Staff
Office of Environmental Review

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
NORTHEASTERN AREA STATE AND PRIVATE FORESTRY
370 REED ROAD — BROOMALL, PA. 19008
Telephone: (215) 461-3170

1950
June 25, 1980

P. McCallister, Chief
Engineering Division
Detroit District, Corps of Engineers
Dept. of the Army
Box 1027
Detroit, MI 48231

Refer to: NCEED-ER
Draft Environmental Impact
Statement, Recreational Boat
Harbor, Cedar River, MI

Dear Mr. McCallister:

We agree that this project would cause little if any adverse impact on upland or wetland vegetation.

Thank you for the opportunity to review this statement.

Sincerely,

for JOHN F. CHANSLER
Assistant Area Director
Resource Protection

STATE OF MICHIGAN

NATURAL RESOURCES COMMISSION
JACOB A. HOEFER
CARL T. JOHNSON
E.M. LAITALA
HILARY F. SNELL
HARRY H. WHITELEY
JOAN L. WOLFE
CHARLES G. YOUNGLOVE

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES
HOWARD A. TANNER, Director

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909

June 27, 1980

Colonel Robert V. Vermillion
U.S. Army Engineer
Detroit District
P.O. Box 1027
Detroit, Michigan 48231

Dear Colonel Vermillion:

The Michigan Department of Natural Resources has reviewed Supplement Number 1: Revisions to General Design Memorandum No. 1 and Draft Environmental Impact Statement for a Recreational Boat Harbor, Cedar River, Michigan. Although we have no objections to this project, we offer the following comments and recommendations.

Property easements at the mouth of the river may be difficult to obtain. These lands were gifts to the state and some deeds contain reverter clauses which prohibit all but park use of these lands. A precise survey of the actual work site may reveal that the project area is not subject to these reverter clauses. A copy of the deed to the site is enclosed for your convenience.

It is likely that the dredged materials will contain organic matter, including old stumps and logs. We cannot permit the disposal of stumps and logs on the beach nourishment area unless the problems of turbidity and visual appeal are adequately addressed.

The project's impact on littoral processes is admittedly uncertain due to the lack of appropriate data. Since the shoreline is now believed to be in an equilibrium condition (page 15), the potential effects of the harbor structure should be addressed. We suggest that future aerial photographs be used to monitor littoral movement so that any problems that arise can receive prompt mitigative measures.

Finally, we recommend that the Cedar River be dredged no further than the turning basin, unless extending the dredged area beyond the turning basin to the State Highway M-35 bridge can be justified. We cannot endorse any

dredging activity unless it can be justified and provides a net benefit to the environment and the public trust.

Thank you for this opportunity to comment and participate in the review process.

Sincerely,

Howard A. Tanner

Howard A. Tanner
Director

Enclosure

July 1, 1980

Serial No. 2254-80
File No. MEN CR

Mr. R. J. Kavalar
Detroit District
Corps of Engineers
P.O. Box 1027
Detroit, Michigan 48231

Dear Mr. Kavalar:

Reference is made to several communications between your office and ours with regard to the proposed Cedar River Harbor of Refuge and the number of boat slips required at that facility.

Based on data collected in 1977, we projected a need for approximately 70 new slips (over and above existing capacity) by 1989 in this area of Michigan. We did not analyze or attempt to predict seasonal demand from Wisconsin. If this factor were added in, the figures would probably compare favorably with the Chicago District's LMRBS (Table F4 of the Federal Design Memorandum No. 1) estimate of 107.

Some of this demand could probably be accommodated by expanding existing facilities at Escanaba and Menominee. How much of the total that could be accommodated at each location becomes a bit subjective at this point, however, and the number of wells that should be provided at Cedar River thus becomes more dependent on the physical capabilities of the site than on overall demand. It would not be unreasonable to conclude that, based on overall seasonal demand in the region, the original proposal of 16 transient and 16 seasonal wells is conservative.

A review and revision of the original plan suggests that up to 52 craft could be moored at that site assuming it is feasible to construct the necessary facilities. We would propose to provide 40 seasonal and 14 transient leaving 44 (70-26) seasonal wells to be accommodated through expansion at Menominee and Escanaba.

Sincerely yours,

Keith Wilson

Keith Wilson, Chief
Waterways Division

KW:JO:pas

F-20

R1026.5 1/80

STATE OF MICHIGAN

NATURAL RESOURCES COMMISSION
JACOB A. HOEFER
CARL T. JOHNSON
E. M. LAITALA
HILARY F. SNELL
HARRY H. WHITELEY
JOAN L. WOLFE
CHARLES G. YOUNGLOVE

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES
HOWARD A. TANNER, Director

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909

July 28, 1980

Mr. Philip A. McCallister, Chief
Engineering Division
U. S. Corps of Engineers
P. O. Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

The Fisheries Division of the Department of Natural Resources has reviewed the proposal for creation of fish reefs at Cedar River Harbor, using materials from the old east pier, and offers the following suggestion for their location.

The lake bottom near the mouth of the Big Cedar River is relatively flat, and the creation of fish reefs along either side of the river mouth would serve to increase fishing opportunities in this area. In order to allow 10-12 foot clearance for recreational boats, the reefs would have to be placed between the 15 and 20 foot contour, with old pier materials deposited in two or three piles approximately six feet high with small but stable bases. Fisheries personnel has offered to bouy these sites at the appropriate time.

Thank you for the opportunity to provide input on this matter. Please call me if and when you would like to have the sites bouyed, or if you have any questions.

Sincerely,

L. N. Witte

L. N. Witte, P.E., Chief
Water Management Division

LNW/ELW:cjs

cc: N. Fogle, Fisheries Division
B. L. Jacob, Dist. 2

MICHIGAN
THE GREAT LAKE STATE

Appendix F

ECONOMICS

APPENDIX F - ECONOMICS OF THE SELECTED PLAN
CEDAR RIVER, MICHIGAN

TABLE OF CONTENTS

TABLES

1. General

The purpose of this section is to analyze the various economic aspects of the alternative plans, insofar as it is possible to quantify these aspects in monetary terms. Both benefits and costs are discussed and a comparison of each is included to more fully understand the economic impact of harbor improvements at Cedar River, Michigan.

2. Methodology

Benefits and costs accruing during the life of the project are annualized such that equivalent average annual costs can be compared to equivalent average annual benefits. This is accomplished by identifying various benefits estimated to accrue over the 50-year project life; identifying currently available costs (including amortization and maintenance costs); and applying an interest rate of 3-1/4 percent. This interest rate is applicable according to the authorization contained in the River and Harbor Act of 1965 (PL 89-298) substantially as recommended by the Chief of Engineers in H.D. 248/89.1. The net effect of converting benefits and costs in this manner is to develop equivalent average annual values.

Comparison of these equivalent average annual charges and benefits is the primary means by which economic justification of a public project is possible. Such a comparison clarifies those proposed projects whose average annual benefits exceed or equal the annual costs of the project. This is the preferable situation if there is to be Federal contribution toward the project.

The choice of 50 years as the project (and therefore economic) life is based on a number of factors. Economic and physical constraints such as physical depreciation of adjacent shore structures, obsolescence, changing requirements for project services, and inaccuracies of overly lengthy projections are considerations in this choice.

1. General

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Comparison of these equivalent average annual charges and benefits is the primary means by which economic justification of a public project is possible. Such a comparison clarifies those proposed projects whose average annual benefits exceed or equal the annual costs of the project. This is the preferable situation if there is to be Federal contribution toward the project.

The choice of 50 years as the project (and therefore economic) life is based on a number of factors. Economic and physical constraints such as physical depreciation of adjacent shore structures, obsolescence, changing requirements for project services, and inaccuracies of overly lengthy projections are considerations in this choice.

Benefits and costs are evaluated in accordance with standard Corps of Engineers practice. Regulation EM 1120-2-113 "Benefit Evaluation for Small Boat Harbors" establishes the means by which pertinent benefits can be quantified. Light-draft navigation, i.e., recreational boating, benefits are evaluated as the gain in annual return received by recreational boaters if the harbor is improved; where annual return represents "the net return on depreciated investment in boats as received by owners of 'for-hire' vessels, after all expenses have been paid." Once this is established, it is possible to estimate the difference between returns to the existing recreational fleet with the existing facilities and returns to this same fleet in the event of harbor improvements. This increase in net return is part of the navigation benefits.

It is also possible that harbor improvements might promote an increase in the number of recreational boats using the harbor. In this case, the full value of the ascribed annual return to owners of these vessels is used in the compilation of navigation benefits. It should be noted that straight line depreciation is used to estimate the average depreciated value by boat classes over the service life of the boat. Average depreciated value for a given class of boats in this analysis is considered to be one-half of the average market value of boats in that same class, taking into account the mix of old and new boats in the fleet at any given time.

Navigation benefits to recreational boating are evaluated as the gain in annual return which owners of pleasure craft would receive as a result of the considered improvement if their boats were used as for-hire vessels. The benefits are equivalent to the net return on the depreciated investment in boats after all expenses have been paid. Depreciated values are taken as approximately 50 percent of the average market value of the boats. Results of a study of recreational boating conducted throughout the United States indicate the approximate range of percentage returns will vary from 10 to 15 percent for outboards, and 8 to 12 percent for inboards and sailboats. For conditions prevailing on Lake Michigan, it is estimated that reasonable percentage returns according to length are: 15

and 11 percent for outboards, 12 and 10 percent for inboards and sailboats, and 15 and 10 percent for inboard/outdrive craft.

Additional benefits considered are harbor of refuge benefits and sport fishing benefits. Harbor of refuge benefits accrue in those instances in which the proposed harbor improvement provides for additional safety and refuge. Recreational sport fishing benefits represent the value of additional angler-days enjoyed by fishermen because of the proposed harbor improvements.

COSTS

3. First Costs. The estimated first costs for the considered improvements are shown in the following tables (Tables F-1 and F-2). The costs are based on AUG 1979 price levels and include estimates for engineering and design activities, and supervision and administrative functions. Accordingly, the costs have been identified as either Federal or non-Federal contributions, and categorized as they pertain to either navigation or recreational facilities.

4. Annual Costs. The estimated investment costs and annual charges for each alternative are shown in Tables F-3 and F-4. Interest during construction is not included in the investment costs as the total construction period is expected to be less than two years. Thus, the investment costs are equal to the estimated first costs (Table F-1 and Table F-2). Interest and amortization charges are based on the previously mentioned economic life of 50 years, and an annual interest rate of 3 1/4 percent. The estimated annual cost for maintenance is $18,000 for alternative one, and $14,800 for alternative two, and is considered to be a Federal responsibility. The total Federal and non-Federal annual charges are used in the benefit/cost analysis.

TABLE F-1

ESTIMATED FIRST COSTS

ALTERNATIVE 1

Item	Navigation Facilities	Recreation Facilities	
Channel Dredging	$ 300,000		$ [illegible]
Breakwaters	1,285,000		[illegible]
Walkways		$ 32,000	[illegible]
Total	$1,585,000	$ 32,000	$1,617,000
Engineering and Design	$ 137,200	$ 2,800	$ [illegible]
Supervision and Administration	149,940	3,060	[illegible]
Subtotal	$1,872,140	$ 37,860	$1,[illegible]
Less Funds to be Contributed	$ 281,070	$ 18,930	$ 300,000
Net Construction Cost	$1,591,070	$ 18,930	$1,610,000
Aids to Navigation	25,000	0	[illegible]
TOTAL FEDERAL FIRST COST	$1,616,070	$ 18,930	$1,635,000
TOTAL NON-FEDERAL FIRST COST	281,070	18,930	300,000
TOTAL FEDERAL & NON-FEDERAL FIRST COSTS	$1,897,140	$ 37,860	$1,935,000

TABLE F-2
ESTIMATED FIRST COSTS
ALTERNATIVE 2

Item	Navigation Facilities	Recreation Facilities	Total
Channel Dredging	$ 230,000		$ 230,000
Breakwater	631,800		631,800
Removal of Existing Stone/ Timber Piles	51,000		51,000
Walkway		$57,000	
Miscellaneous Construction	6,800		6,800
Total	$ 919,600	$57,000	$ 976,600
Engineering and Design	$ 202,100	$12,900	$ 215,000
Supervision and Administration	78,020	4,980	83,000
Subtotal	$1,199,720	$74,880	$1,274,600
Less Funds to be Contributed	$ 179,790	$37,440	$ 217,230
Net Construction Cost	$1,019,930	$37,440	$1,057,370
Aids to Navigation	16,700	0	16,700
Right-of-Way	15,000	0	15,000*
TOTAL FEDERAL FIRST COST	$1,036,630	$37,440	$1,074,070
TOTAL NON-FEDERAL FIRST COST	179,790	37,440	232,230**
TOTAL FEDERAL AND NON-FEDERAL FIRST COSTS	$1,216,420	$89,880	$1,306,300**

* Non-Federal Cost
**Includes $15,000 Right-of-Way Costs

TABLE F-5

ESTIMATED AVERAGE ANNUAL CHARGES

ALTERNATIVE 1

Investment Costs	Navigation Facilities	Recreation Facilities	Total
Federal First Cost	$1,616,070	$18,930	$1,635,000
Non-Federal First Cost	281,070	18,930	300,000
Total Federal and Non-Federal First Cost	$1,897,140	$37,860	$1,935,000
Annual Charges			
Federal			
Interest (.0325)	$ 52,100	$ 1,040	$ 53,140
Amortization (.00823)	13,200	260	13,460
Maintenance	10,000	8,000	18,000
Total	$ 75,300	$ 9,300	$ 84,600
Non-Federal			
Interest (.0325)	$ 9,500	$ 200	$ 9,750
Amortization (.00823)	2,420	50	2,470
Maintenance	0	0	0
Total	$ 11,970	$ 250	$ 12,220
Total Annual Charges	$ 87,270	$ 9,550	$ 96,820

TABLE F-4
ESTIMATE OF ANNUAL CHARGES
ALTERNATIVE 2

Investment Costs	Navigation Facilities	Recreation Facilities	Total
Federal First Cost	$1,036,630	$37,440	$1,074,070
Non-Federal First Cost	179,790	52,440*	232,230
Total Federal and Non-Federal First Costs	$1,216,420	$89,880	$1,306,300
Annual Charges			
Federal			
Interest (.0325)	$ 33,690	$ 1,220	$ 34,910
Amortization (.00823)	8,530	310	8,840
Maintenance	10,000	4,800	14,800
Total	$ 52,220	$ 6,330	$ 58,550
Non-Federal			
Interest (.0325)	$ 5,840	$ 1,710	$ 7,550
Amortization (.00823)	1,480	430	1,910
Maintenance	0	0	0
Total	$ 7,320	$ 2,140	$ 9,460
Total Annual Charges	$ 59,540	$ 8,470	$ 68,010

*Includes $15,000 Right-of-Way Costs.

5. Existing Conditions. The proposed improvements would benefit recreational navigation and both sport and commercial fishing in the Michigan waters of Green Bay. These activities are presently hampered by the limited public harbor facilities on Green Bay. Cedar River Harbor is in a state of severe deterioration, with shoaling occurring at the mouth of the Cedar River. This situation is making it hazardous for large boats and transient boaters unfamiliar with Cedar River to enter the harbor area. There are no permanent docking, mooring or handling facilities at Cedar River Harbor; but, it is possible to temporarily moor boats to the existing pier. Conversations with area residents indicate that approximately 30 recreational boats are in the harbor area during the summer months, and others are kept on trailers rather than risking leaving them unattended in the harbor. It is estimated that as these boaters are willing to use such an unsafe location to moor their craft, that if new harbor facilities were provided these 30 craft would remain at Cedar River. Cedar River Harbor is located midway between Menominee and Escanaba Harbors, a 54 mile shore reach. Establishing a harbor of refuge at Cedar River is consistent with the Michigan State Waterways Commission plan to provide harbors along the coastline so that no boater will ever be more than 15 miles from a safe harbor.

6. EXISTING AND PROSPECTIVE RECREATIONAL BOAT TRAFFIC

The demand for recreational boating facilities in the Cedar River area was identified by the Lake Michigan Regional Boating Survey (LMRBS) conducted by the Chicago District, Army Corps of Engineers. This survey measured the 1971 existing and projected demand for recreational boating facilities in Delta and Menominee Counties, Michigan and Marinette and Onconto Counties, Wisconsin. Table F-6 displays the projected demand using a medium demand allocation. By 1980 it is estimated that there will be a demand for 51 slips and ten years later the demand will be more than double. This is consistent with the State of Michigan DNR projection

(cited in HR 1 July 80) ". . . for approximately . . . 70 new slips (over and above existing capacity) by 1989 in this area of Michigan." They also state that including the probable demand from the State of Wisconsin that the LMRBS estimate of 107 slips is accurate and realistic.

The Michigan Department of Natural Resources Waterways Division indicated their intent to provide facilities for boats of various sizes upon completion of the Federal Project to improve the harbor area. The plan is to provide 52 boat slips (Table F-5), which is equivalent to the 1980 LMRBS projected demand, but the MDNR indicates that there may be expansion at Menominee and Escanaba to accommodate the excess demand of 107 slips by 1990 (1 July 80 letter).* It is assumed that the 40 locally based slips would be fully occupied during the boating season and the 12 transient slips also would be fully utilized. This is based on the previously discussed demand determination (LMRBS).

TABLE F-5

PROPOSED PLAN OF EXPANSION

	NUMBER OF SLIPS		
LENGTH (Feet)	POWER BOATS	SAILBOATS	TOTAL
20-29	21	8	29
30-39	10	6	16
40-49	3	2	5
50+	1	1	2
			52

Mooring facilities could be expanded by extending the mooring basin eastward. This is cleared, open land which would accomodate economical construction.

*see Appendix E, page E-20

TABLE F-6

DEMAND FOR PERMANENT

MOORING FACILITIES 1980-2020*

Year	No. of Small Berths & Moorings	No. of Large Berths & Moorings	Total
1980	35	16	51
1990	73	34	107
2020	156	73	229

*Based on Medium demand allocation

Source: LMRBS

7. Recreational Navigation Benefits

Light draft navigation benefits, as described earlier, are evaluated as the gain in annual return which owners of pleasure craft would receive as a result of the considered improvement, and if their boats were used as "for-hire" vessels. Within the ranges discussed earlier, the annual rate of return assigned to a particular type of boat depends on such factors as length of season, concentration of population, availability and cost of other types of outdoor recreation, cost of access to other small boat harbors, and income range of the using public. For conditions prevailing on Lake Michigan in the Cedar River area, it is estimated that reasonable annual rates of return are 8 percent for inboards; 12 percent for the mix of outboards/inboards/inboard-outdrives; 10 percent for sailboats; and 8 percent for auxiliary sailboats.

An estimate was made of the current percent of optimum use possible of the recreational fleet, as well as the percent of optimum use which would be possible with the considered improvement. Because there are 30 recreational craft which presently use the harbor, it is necessary to display

those navigation benefits separately. These craft will be assumed to receive a 75 percent future return on their depreciated investment (Table F-8). This is a result of being able to use the harbor in its present state (before improvement) but they are susceptible to damage from waves, wind, or vandalism; and there are no ancillary facilities such as pump out equipment, electricity, or water. Following completion of the project they will be assumed to receive a 100 percent future return on their depreciated investment, this calculation is in Table F-9 and includes the additional 10 future locally based craft. Both this estimate, plus the annual rates of return assigned to the various boat classes are displayed in Tables F-8, F-9, and F-10. "Recreational Craft Benefits." The increase in optimum use due to the proposed harbor improvement is considered to be a benefit that should be counted in the process of economic justification. Benefits for locally-based boats are reduced by an appropriate percentage which corresponds to the estimated number of days per season such boats are expected to be away from Cedar River Harbor on cruise. Boats on cruise avail themselves to harbor improvements at other harbors, thus, time spent at harbors other than Cedar River is not included in the analysis.

The derivation of recreational navigation benefits is shown in Tables F-8, F-9, and F-10. The number determined to be power boats or sailboats was estimated using the corresponding proportions from Menominee and Escanaba Harbors during 1978. The existing 30 craft (Table F-8) are assumed to have similar characteristics to the projected locally based craft (Table F-9). (It was necessary to estimate these as an actual description of each boat was unavailable.) For example, the number of cruisers 20-29 feet long, to occupy the Cedar River slips was estimated by averaging the 64.7 percent of 20-29 feet cruisers in Menominee, and the 49.2 percent in Escanaba. Thus it was assumed that 58.3 percent of the total cruisers at Cedar River would be 20-29 feet in length. Accordingly, 21 boats were designated as being cruisers between 20 and 29 feet long.

In order to evaluate the number of transient craft expected to occupy Cedar River's slips it is necessary to describe the local existing fleet

(Table F-7). Within an approximate 50 mile range of Cedar River Harbor there are 21 harbors, with 1,039 permanent slips, this includes both Michigan and Wisconsin. The following table (F-7) taken from the LMRBS (Great Lakes Cruising Club, Port Pilot and Log Book, 1972 Revision) identifies the number of permanent slips in each harbor.

TABLE F-7

EXISTING AREA FLEET

HARBOR	PERMANENT SLIPS
Gladstone, MI	46
Escanaba, MI	45
Menominee, MI	86
Onconto, WI	75
Pensaukee, WI	6
Big Suamic, WI[1]	5
Green Bay, WI[1]	177
Little Sturgeon Bay	4
High Cliff	25
Egg Harbor	58
Fish Creek	57
Ephraim	65
Sister Bay	63
Ellison Bay	35
Gills Rock	35
Washington Harbor	12
Jackson Harbor	1
Detroit Harbor	32
Rowley Bay	15
Bailey's Harbor	3
Sturgeon Bay	194
TOTAL	1,039

[1]Within 60 miles of Cedar River Harbor

Source: Great Lakes Cruising Club, Port Pilot and Log Book, 1972 Revision.

The transient craft benefits for Cedar River were based on occupancy of the 12 projected slips and 7 seasonal slips. The 7 seasonal slips are derived assuming that the total seasonal craft are expected to be on cruise, away from Cedar River, approximately 15-30 percent of the season (assumed to be a 120 day season). For example; 16 locally based 20'-29' cruisers are on cruise 15 percent of the season, (16 x 15 = 240 days that a slip would be open), this is then divided by the 120 day season to equate it to locally based craft (240/120 = 2 equivalent slips). This was done for all the locally based slips and thus we are given an additional 7 slips for transient boaters to occupy. The 19 transient craft benefits were then evaluated assuming occupancy of approximately 73 percent of the season. This weighted average was based on 1979 data from MDNR Escanaba and Menominee harbors. Escanaba has 16 ships which were occupied 40 percent of the 120 day season and Menominee had 100 percent occupancy of their 19 transient slips. The benefit for locally based craft is $71,790 (F-8 and F-9), and $28,460 for transient craft (F-10).

8. Harbor of Refuge Benefit

The $5,550 Harbor of Refuge benefit was determined by projecting the number of boats expected to be caught within the 54 mile shore reach from Escanaba and Menominee (the only two existing harbors of refuge in northwestern Green Bay). Cedar River is located approximately halfway between those harbors and 6 boats are expected to be cruising in the 54 mile reach, thus half of those craft will be expected to be able to reach Cedar River safely.*

The actual damage figure was estimated from boat damage incurred to Port Washington craft from storms in 1970. At that time 7 craft had approximately $6,000 in damage, which is about $860 each. Based on the earlier estimation that 3 boats would be using Cedar River for refuge during storms the estimated damage would be $2,580 (1970 prices), which when updated, would be equivalent to $5,550; thus the proposed development

*projection based on LMRBS, p.50

TABLE F-8

RECREATIONAL CRAFT BENEFITS -- LOCALLY BASED BEFORE IMPROVEMENT

Type of Craft	Length	Number of Boats	Draft feet*	Depreciated Investment			Return of Depreciated Investment				On Cruise During 120 Day Season		
				Ave $	Total $	Ideal %	Present %	Future %	Gain %	Value $	Ave No. Days	% Season	Value
Cruisers Outboard	20'-29'	12	2.75	5,700	68,400	12	25	75	9	6,160	15	12	740
Inboard	30'-39'	6	3.25	18,500	111,000	8	25	75	6	6,660	30	25	1,670
Inboard/ Outdrive	40'-49'	2	3.25	51,850	103,700	8	25	75	6	6,220	30	25	1,550
	50' and Over	0	4.00	89,900	0	8	25	75	6	0	30	25	0
Sailboats	20'-29'	5	5.50	11,500	57,500	10	25	75	7.5	4,310	15	12	520
	30'-39'	3	5.50	20,000	60,000	8	25	75	6	3,600	30	25	900
	40' and Over	2	5.50	50,000	100,000	8	25	75	6	6,000	30	25	1,500
		30								$32,950			$6,880

Equivalent average Annual Benefit: $32,950 - $6,880 = $26,070

*add 2 feet to accomodate wave action and squat

TABLE F-9

RECREATIONAL CRAFT BENEFITS -- LOCALLY BASED AFTER IMPROVEMENT

Type of Craft	Length	Number of Boats	Draft feet*	Depreciated Investment			Return of Depreciated Investment				On Cruise During 120 Day Season		
				Ave $	Total $	Ideal %	Present %	Future %	Gain %	Value $	Ave No. Days	% Season	Value
Cruisers													
Outboard	20'-29'	16	2.75	5,700	91,200	12	0	100	12	10,940	15	12	1,310
Inboard	30'-39'	8	3.25	18,500	148,000	8	0	100	8	11,840	30	25	2,960
Inboard/ Outdrive	40'-49'	3	3.25	51,850	155,550	8	0	100	8	12,440	30	25	3,110
	50' and Over	0	4.00	89,900	0	8	0	100	8	0	30	25	0
Sailboats	20'-29'	7	5.50	11,500	80,500	10	0	100	10	8,050	15	12	970
	30'-39'	4	5.50	20,000	80,000	8	0	100	8	6,400	30	25	1,600
	40' and Over	2	5.50	50,000	100,000	8	0	100	8	8,000	30	25	2,000
		40								$57,670			$11,950

Equivalent Average Annual Benefit: $57,670 - $11,950 = $45,720

*add 2 feet to accomodate wave action and squat

TABLE F-10

RECREATIONAL CRAFT BENEFITS -- TRANSIENT

AFTER IMPROVEMENT

Type of Craft	Length	Number of Boats	Draft feet*	Depreciated Investment			Return of Depreciated Investment			
				Ave $	Total $	Ideal %	Present %	Future %	Gain %	Value $
Cruisers Outboard	20'-29'	6	2.75	5,700	34,200	12	0	100	12	4,100
Inboard	30'-39'	3	3.25	18,500	55,500	8	0	100	8	4,440
Inboard/ Outdrive	40'-49'	1	3.25	51,850	51,850	8	0	100	8	4,150
	50' and Over	1	4.00	89,900	89,900	8	0	100	8	7,190
Sailboats	20'-29'	2	5.50	11,500	23,000	10	0	100	10	2,300
	30'-39'	3	5.50	20,000	60,000	8	0	100	8	4,800
	40' and Over	3	5.50	50,000	150,000	8	0	100	8	12,000
		19[1]								$38,980

$38,980 x .73[2] (Seasonal occupancy weighting percentage) = $28,460

[1]Equivalent Locally Based Boat

[2]Based on transient craft occupancy notes at Escanaba and Menominee Harbors.

*add 2 feet to accomodate wave action and squat

of Cedar River as a harbor of refuge would eliminate those damages, and can be counted as their harbor of refuge benefit.

FISHING BENEFITS

9. Sport Fishing

A pier at Cedar River Harbor would provide additional recreational fishing access to Lake Michigan for nonboating area fishermen. Information from the Wisconsin Creel Census 1969-1975 provided the basic data necessary for this sport fishing analysis. It is assumed that 50 lineal feet of pier are required per fisherman, to minimize overcrowding, and that the fisherman turnover rate per day is estimated to be three. The percentage of fishermen using the pier during each month was estimated assuming that sport fishing was comparable to charter fishing on Lake Michigan. The loading percentages in Tables F-11 and 12 are indicative of the charter fishing industry during 1975, April through November.

Tables F-11 and 12 are an indication of the projected fisherman use days for the fishing season (April through November) on the Cedar River Harbor pier. The total minimum fisherman use days equal 12,922 days (alternative one), which is based on the above assumption and 2,100 lineal feet of pier. The total minimum fisherman use days for alternative two equal 6,768 days, this is based on the total length of both piers 875 feet and 230 feet. This estimate is conservative as it does not allow for overloading (more than one fisherman for every 50 feet) and nonseasonal usage (December thru March).

It was not known what amount of fisherman days were trout and salmon, and non-trout, so the total number of user days were divided equally between each category (Table F-13). The MDNR provided the 1979 user day value for trout and salmon fishing and non-trout fishing, they are $7.70

and $3.29 respectively. Thus, the total sport fishing benefits are valued at $71,000 (alternative one) and $37,190 (alternative two).

10. Commercial Fishing

The existing commercial fishing in Cedar River Harbor involves six fishing boats which supply a company located in Cedar River, Michigan. As shoaling has been an ongoing problem, the depth of the harbor entrance has decreased causing the company to dock their largest vessel at Menominee Harbor, approximately 30 miles from their home base. The decreasing depth of the harbor entrance has also been the cause for occasional grounding of their smaller vessels. Improving Cedar River Harbor by dredging its mouth would eliminate the present safety hazard and allow the company to bring their largest vessel back to Cedar River and avoid the increased costs of docking and travel to Menominee Harbor.

To avoid grounding of their vessels, the fishermen have had to operate at approximately one quarter less than their loading capacity. The commercial fishing benefit was determined using the above information as a basis, and assuming the total catch equals three-fourths of the 5 vessels actual capacity, thus, the total increase would be approximately 430 tons.

TABLE F-14

1979 COMMERCIAL FISH CATCH CEDAR RIVER HARBOR

Fish	Tons	Weighted Average	Value Per Ton	Weighted Price Per Ton
	(2,240 lbs.)	%	$	$/Ton
Alewives	704.5	.543	$ 34.20	$ 18.57
Burbot	4.8	.004	105.00	0.42
Smelt	257.3	.198	112.60	22.29
Suckers	265.7	.205	71.70	14.70
Whitefish	64.3	.050	2,118.50	105.92
	1,296.6	1.000	$2,442.00	$161.90
				say $162.00

Source: Great Lakes Fishery Laboratory July 1980.

TABLE F-11

CEDAR RIVER BREAKWATER USAGE (Fishermen Days)

Alternative 1

Month	(A) Percentage of Charter Fishing[1]	(B) Total Fishermen/ Breakwater[2]	(C) Percent of Fishing (A x B)	(D) Daily Turnover Rate	(E) Total Days/ Month	(F) Total Monthly Breakwater Use (C x D x E)
April	15	42	6.3	3	30	567
May	25	42	10.5	3	31	977
June	55	42	23.1	3	30	2,079
July	80	42	33.6	3	31	3,125
August	85	42	35.7	3	31	3,320
September	55	42	23.1	3	30	2,079
October	15	42	6.3	3	31	586
November	5	42	2.1	3	30	189
					Total	12,922

[1]Percent of capacity in the charter boat fishing industry, which is assumed indicative of sport fishing activity -- Source: "Wisconsin Lake Michigan -- Charter Fishing Industries, 1975".

[2]Based on 2,100 lineal feet of useable breakwater.

TABLE F-12

BREAKWATER USAGE (Fishermen Days)

Alternative 2

Month	(A) Percentage of Charter Fishing[1]	(B) Total Fishermen/ Breakwater[2]	(C) Percent of Fishing (A x B)	(D) Daily Turnover Rate	(E) Total Days/ Month	(F) Total Monthly Breakwater Use (C x D x E)
April	15	22	3.3	3	30	297
May	25	22	5.5	3	31	511
June	55	22	12.1	3	30	1,089
July	80	22	17.6	3	31	1,637
August	85	22	18.7	3	31	1,739
September	55	22	12.1	3	30	1,089
October	15	22	3.3	3	31	307
November	5	22	1.1	3	30	99
					Total	6,768

[1]Percent of capacity in the charter boat fishing industry, which is assumed indicative of sport fishing activity -- Source: "Wisconsin Lake Michigan -- Charter Fishing Industries, 1975".

[2]Based on 1,105 lineal feet of useable breakwater.

TABLE F-13

SPORT FISHING BENEFITS

	User Days	
	Alternative 1	Alternative 2
User Day Value	6,461	3,384
Trout-Salmon $7.70	$49,750	$26,050
Non-Trout $3.29	$21,250	$11,130
Total	$71,000	$37,180

The weighted average market value of the commercial fish catch is $162 per ton (Table F-14). This information is displayed in Table F-9 and based on information from the Great Lakes Fishery Laboratory. The total commercial fishing benefit is estimated to be $69,660 (430 additional tons x $162/ton).

11. Summary of Benefits

The estimated average annual benefits attributable to each alternative are summarized in Table F-15. The type of benefits are identified as either navigation, recreational craft, harbor or refuge, and commercial or recreational fishing, sport fishing.

12. Economic Justification

Through a comparison of estimated average annual costs (Table F-3 and 4) and benefits (Table F-15), it is shown that the Alternative 1 and 2 proposed improvements to Cedar River Harbor are economically justified (Table F-16). The total benefit to cost ratio for Alternative One is 2.55 with net benefits of $149,640, while Alternative Two has a benefit to cost ratio of 3.13 and net benefits of $144,640. Finally, a project must be justifiable on only its navigation benefits, and Cedar River is feasible for both Alternatives One and Two.

TABLE F-15

SUMMARY OF BENEFITS

Type of Benefit	Alternative 1	Alternative 2
GENERAL NAVIGATION		
1. Recreational Craft		
a. Locally based craft before construction	$ 26,070	$ 26,070
b. Locally based craft after construction	45,720	45,720
c. Transient craft after construction	28,460	28,460
2. Harbor of Refuge	5,550	5,550
3. Commercial Fishing	69,660	69,660
Total	$175,460	$175,460
RECREATION		
1. Sport Fishing	$ 71,000	$ 37,190
Total	$ 71,000	$ 37,190
TOTAL BENEFIT	$246,460	$212,650

TABLE F-16

COMPARISON OF BENEFITS AND COSTS

Alternative 1

Improvement	Annual Benefit	Annual Cost	Benefit Cost Ratio	Net Benefits (Benefits-Costs)
General Navigation	$175,460	$87,270	2.01	$ 88,190
Recreation	71,000	9,550	7.43	61,450
Total	$246,460	$96,820	2.55	$149,640

Alternative 2

Improvement	Annual Benefit	Annual Cost	Benefit Cost Ratio	Net Benefits (Benefits-Costs)
General Navigation	$175,460	$60,160	2.92	$115,300
Recreation	37,190	7,850	4.74	29,340
Total	$212,650	$68,010	3.13	$144,640

Appendix G

FINAL

ENVIRONMENTAL IMPACT STATEMENT

FINAL ENVIRONMENTAL IMPACT STATEMENT
RECREATIONAL NAVIGATION IMPROVEMENTS
CEDAR RIVER, MICHIGAN

RESPONSIBLE AGENCY:
DETROIT DISTRICT CORPS OF ENGINEERS

ABSTRACT

A small craft harbor improvement is proposed at Cedar River, Michigan. The project would consist of (1) construction of a new east pier, (2) rehabilitation of the old west pier, (3) dredging of an entrance and inner channel with turning basin, (4) removal of the remnants of the old east pier, and (5) beach nourishment of the shoreline zone adjacent to the lakeward side of the proposed east pier. Benefits to the community would be substantial due to increased sport fishing, boating, and commercial fishing. Boating safety would be enhanced as currently the deteriorated breakwaters do not function properly. Shoaling has reduced the water depth at the river mouth and the nearest harbor of refuge is 25 miles away. Construction activities may have a temporary impact on air and water quality, but no significant long-term impacts are expected. No major change in overall land use is foreseen, although an increase in use would exert some additional demand on area resources.

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ENVIRONMENTAL STATEMENT

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SUMMARY

Major Conclusions and Findings

A plan for the improvement of Cedar River as a boat harbor was discussed in the General Design Memorandum No. 1 in 1968. At that time, there were no requirements for preparation and dissemination of an environmental impact statement. The project, however, was not implemented. In 1979, the project was reactivated at the request of the State of Michigan. The selected plan (from 1968) has been re-examined and evaluated environmentally.

The National Economic Development Plan (NED) addresses the maximizing of net economic benefits. Examination of the four alternatives indicated that alternative 2 (Selected Plan) provided the greatest economic benefits.

The Environmental Quality Plan (EQ) is that alternative which makes a net positive contribution to the environmental quality of the area. Alternative 2 provides additional aquatic habitat (rubblemound breakwaters) protects the inner mouth of the river from wind caused erosion, provides for additional beach, offshore fishery habitats, and would provide for recreational opportunities.

Because Alternative 2 qualifies as both the NED and EQ plan, it was chosen as the Selected Plan.

Areas of Controversy and Unresolved Issues

There are currently no major areas of controversy on the project. The Federal Fish and Wildlife Service would like the excess rubble from the old breakwaters utilized for the creation of an underwater fishery habitat. A decision was made by the Michigan Department of Natural Resources to place the rubble offshore in two or three piles to be used as fishery habitat. The piles would be placed in water deep enough to pose no navigational hazard to recreational or commercial watercraft.

Relationship to Environmental Requirements

The project has been formulated to comply with federal and state laws, as well as executive orders. Please see Table G-1. A Final 404 Evaluation is included in this EIS, (Section 7).

TABLE G-1

RELATIONSHIP OF PLANS TO ENVIRONMENTAI REQUIREMENTS
(Name of Selected, or tentatively Selected, Plan)

Federal Policies	Alternative 1	Alternative 2 (Selected Plan)	Alternative 3	Alternative 4 (No Action)
Fish and Wildlife Coordination Acts, 16 U.S.C. 661 et seq.	F*	F	F	N/A****
Clean Water Act of 1977, 33 U.S.C. 1344	P**	P	N	N/A
National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470 et seq.	F	F	F	N/A
National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 et seq.	P	P	P	N/A
Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et seq.	F	F	F	N/A
Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et seq.	F	F	F	N/A
Protection of Wetlands (E.O. 11990)	F	F	F	N/A
Land Use Plans				
Michigan Coastal Management Program	F	F	F	N/A

NOTES: The compliance categories used in this table were assigned based on the following definitions:

F* Full compliance -- All requirements of the policy and related regulations have been met.

P** Partial compliance -- Some requirements of the policy and related regulations remain to be met.

N*** Noncompliance -- None of the requirements of the policy and related regulations have been met.

N/A**** Not applicable

SECTION 1
NEED FOR AND OBJECTIVES OF ACTION

1.01 The purpose of the project is to provide a harbor of refuge for both transient craft and locally owned pleasure and commercial fishing boats at Cedar River, Michigan. At present, the nearest deep draft harbors are at Menominee and Escanaba, each about 25 miles from Cedar River. To traverse the 50 miles of Green Bay's north shore between Menominee and Escanaba is considered unsafe by most boaters without a more centrally located harbor. Cedar River would provide that harbor of refuge with the proposed improvements.

1.02 The project would also increase the general recreational use of the Cedar River area. The utilization of the offshore fishery habitats would be increased as the improvements would provide safety and convenience for many small fishing boats. The walkway on the proposed east pier would also allow those without boats to better utilize the area's fishing potential. For additional discussion of benefits see Appendix F.

1.03 The wooden east pier constructed more than 50 years ago is now largely deteriorated and no longer protects the River mouth from wave action and littoral drift. The resulting shoaling of the River mouth has limited use of the harbor to shallow draft boats and has caused the Cedar River commercial fishermen to work out of Menominee rather than risk running aground at Cedar River.

1.04 Cedar River has never been used as a stopping place for larger pleasure craft because of the shallow channel and lack of facilities. Completion of the project would add a substantial economic base to the Cedar River community through increased use of the area.

SECTION 2
DESCRIPTION OF THE PROPOSED PROJECT
AND ALTERNATIVES

Scope

2.01 A recreational refuge harbor is proposed at Cedar River, Menominee County, Michigan (Figure I). The harbor would provide additional facilities for small craft in Green Bay and Northern Lake Michigan. The completed project would supply general navigation facilities, marina slips, sport fishing access, and support facilities.

Authority

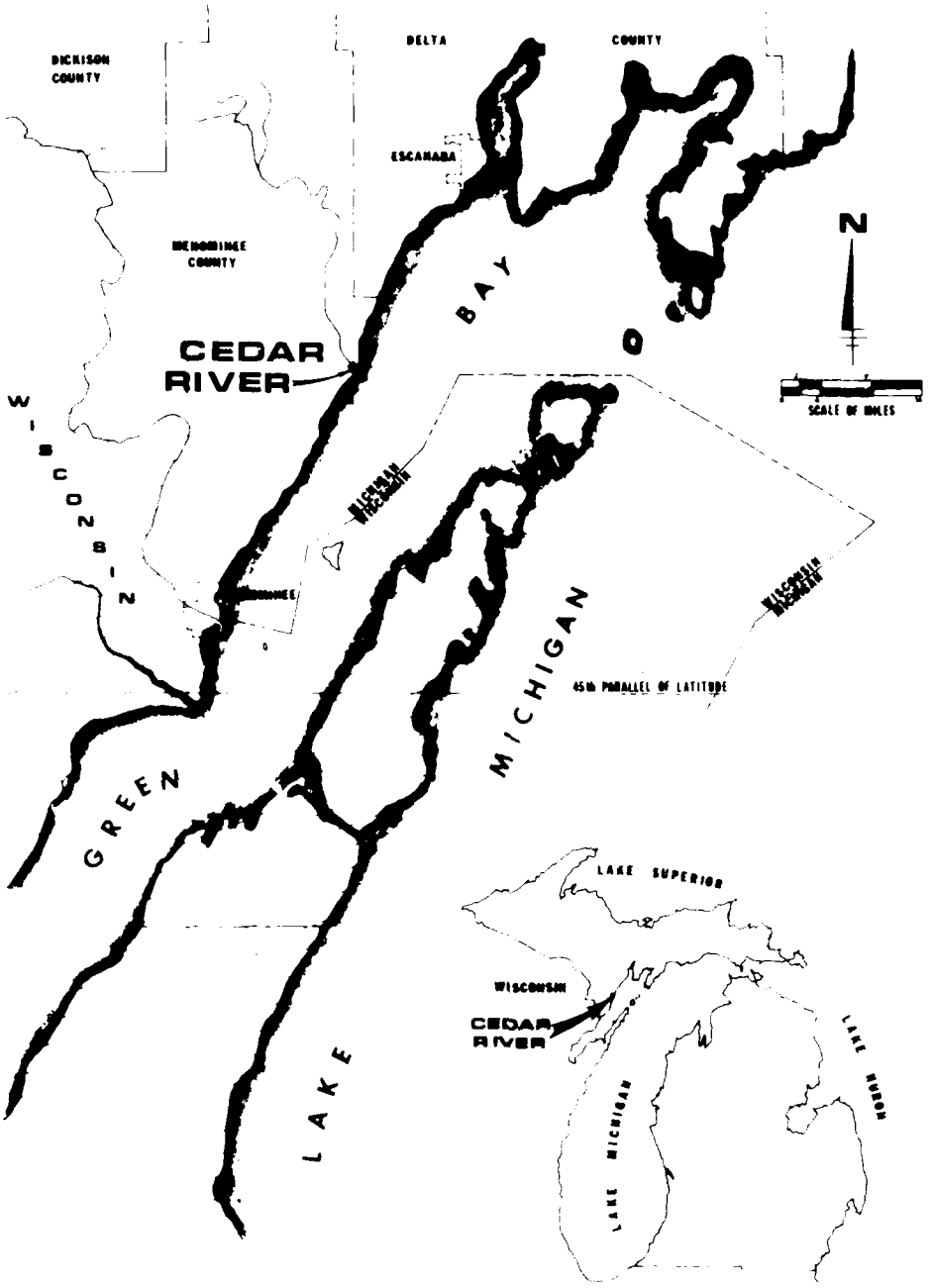
2.02 The River and Harbor Act of 1965 (P.L. 89-248) authorized that the project for Cedar River Harbor, 1882 (S. Ex. Dec. 12, 47th Cong.), be modified to include two parallel entrance piers, a new east rubble mound pier, deepening the river and river mouth, and a turning basin.

2.03 The Chicago District of the Corps of Engineers completed a Design Memorandum (GDM) No. 1 of Cedar River Harbor in August of 1968. This memorandum presented some preliminary costs, soil and geological information, and a hydraulic analysis.

Proposed Project

2.04 The proposed project (Figure II) would consist of a new 875-foot rubble mound pier extending into the Lake to the 10-foo depth contour line. A new pierhead and navigation light would be built at the end of this new east pier. The existing west pier will remain with its warning light, but the pier could be rehabilitated with cover stone if further analysis indicates it to be necessary. Harbor improvements based on estimated boat use are discussed in detail in Section F of the Supplemental Report.

2.05 A channel 10 feet deep and about 100 feet wide would be dredged from the 10-foot contour in the lake to the river mouth. From the river mouth



SITE LOCATION

FIGURE I

AD-A107 091 CORPS OF ENGINEERS DETROIT MI DETROIT DISTRICT F/G 13/2
RECREATIONAL BOAT HARBOR, CEDAR RIVER, MICHIGAN. REVISIONS TO G--ETC(U)
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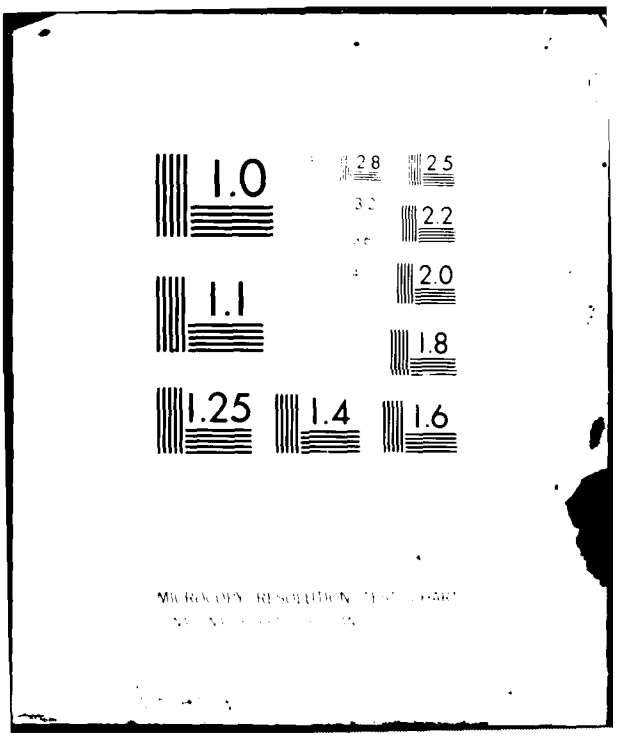
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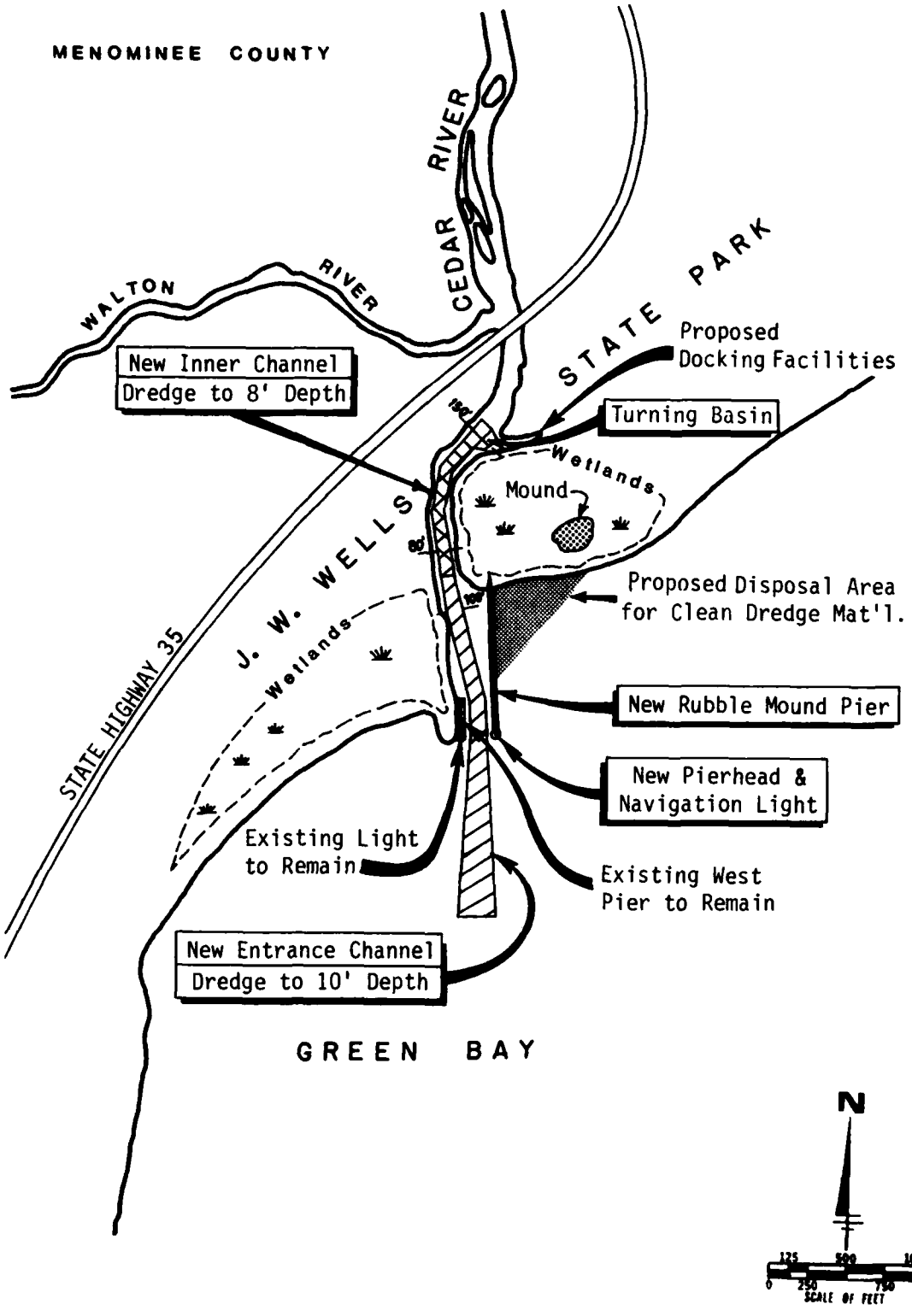


ALTERNATIVE 2

PROPOSED PLAN

FIGURE II

upstream to the end of the turning basin (approximately 900 feet), a channel eight feet deep and about 80 feet wide would be dredged. Within the river channel a 150-foot turning basin would also be deepened.

2.06 A walkway would be provided on the east pier to allow for recreational fishing. Aids to navigation would be constructed by the U.S. Coast Guard. Preliminary plans for docking facilities have been submitted by the Michigan DNR for possible construction in a currently existing canal (Figure II). The docking facilities to be constructed by the Michigan Department of Natural Resources, would be located in the canal on the east shoreline of the Cedar River. The canal is approximately 1800 feet up the channel from the proposed pier entrance, is about 400 feet long by 90 feet wide and would have a project depth of 6 feet. Thirty individual boat slips of varying sizes would be constructed within the canal. Private enterprise entities are expected to supply materials and services and operate the facilities. Docking facilities for commercial carriers would be the responsibility of the commercial enterprise.

2.07 Approximately 38,000 cubic yards of dredged material would be initially removed from the channel area. This material consists of sand and gravel with 3-5% wood debris and would be placed as beach nourishment along the shoreline on the lakeward side of the east pier (Figure II). The material is "unpolluted sand suitable for beach nourishment," (EPA letter, pg. G-53). Subsequent maintenance dredge material would continue to be placed as beach nourishment in the initial area as long as the material remained uncontaminated. Maintenance dredging of the channel would be performed once every two years. Logs or stumps would not be placed on the beach nourishment area if encountered during dredging activities. If concentrations of sawdust or detrital material are found, they would be disposed of in an approved location. Only clean dredged sand from the channel would be placed at the nourishment site.

2.08 The total first cost associated with this project is estimated at $1,306,300 of which $1,074,070 would be a Federal contribution. Annual cost include amortization of the first costs over a 50 year economic life period as well as interest and maintenance of the facility. The annual cost is estimated at $68,010 of which $58,550 would be the Federal contribution per year. Sport fishing, commercial fishing, recreational docking facilities, and a harbor of refuge are considered the primary benefits of the proposed facility. The annual benefits to these activities have been estimated at $212,650. This annual benefit exceeds the annual cost by a factor of 3.13

(benefit-cost ratio) thus economically justifying the improvements. For a detailed analysis see Paragraph 28 through 39 of the Supplemental Report.

2.09 The east pier would replace a rock filled wooden pier that was built and used near the turn of the century. That pier is now greatly deteriorated with only a few vertical piling and tie rods remaining near the surface. Some sections have been washed away (8). This material would be removed and placed offshore as underwater fishery habitats.

Project Schedule (Projected)

2.10 First schedule anticipates construction to begin in January of 1982 based on availability of anticipated funds. Construction is expected to take place over a period of about two years.

Alternatives

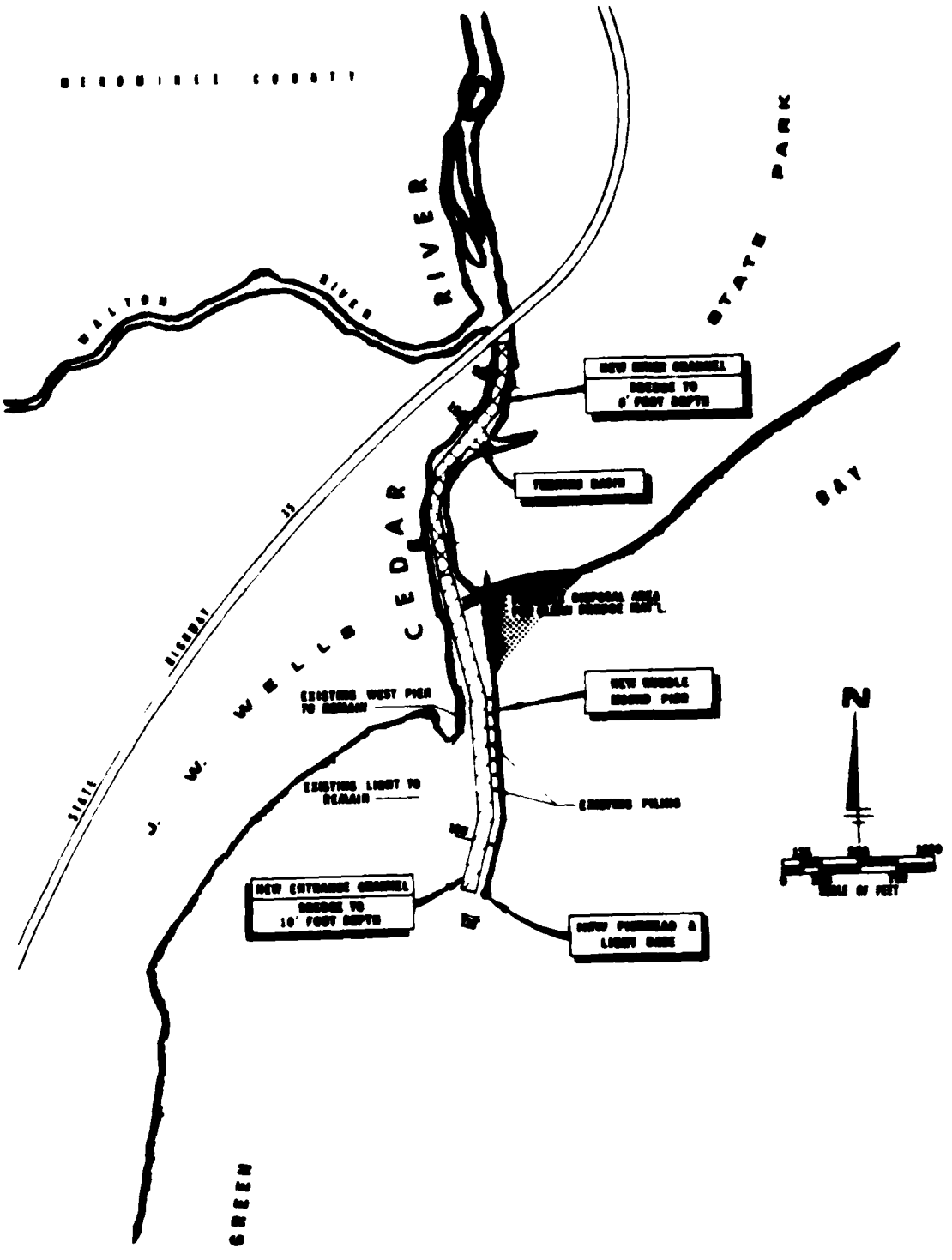
2.11 Three alternative pier designs have been considered in the preparation of design specifications. The designs are primarily concerned with the length of the pier, as length would have a large influence on shoaling and protective qualities. The no action alternative is also considered in this environmental evaluation.

2.12 Alternative 1 is the construction of a 2,100 foot long rubblemound pier as authorized by the River and Harbor Act of 1965. Studies conducted since authorization of the original plan have shown that shore erosion could be minimized with a shorter pier design (Figure IIa).

2.13 Alternative 2, the modified authorized plan, is the Selected Plan. This plan calls for the construction of a straight pier about 875 feet long. This shorter pier design would necessitate removal of at least a portion of the old pier to allow an unobstructed flow in the river (Figure II).

2.14 Alternative 3 is the construction of an even shorter pier than in Alternative 2. This alternative would require most of the old pier to be removed.

2.15 Please refer to Other Plans Investigated (pg. 6) and the System of Accounts - Table 1 in the main report and Table G-3 in Section 4 page G-26 for an indepth evaluation of alternatives.



ALTERNATIVE 1

Figure IIa

SECTION 3

THE AFFECTED ENVIRONMENT

Location

3.01 The Village of Cedar River is located on Green Bay in Northwestern Lake Michigan at the mouth of the Cedar River (Figure I). The Village is in Menominee County, Michigan, about midway between the Cities of Escanaba and Menominee. It is about 25 miles to either of these Cities from Cedar River.

Climate

3.02 The climate of Cedar River is strongly influenced by Lake Michigan throughout most of the year. The prevailing southerly winds tend to moderate the temperature as they blow across the open waters of the Lake thus cooling the area in the spring and summer and moderating the colder temperatures in the fall (3). The northerly winds of winter and the ice cover on Lake Michigan result in temperatures similar to those found inland during the winter months. The northern winter winds also dump most of their snow close to the Lake Superior side of the peninsula leaving the Escanaba area with only about 58 inches of snow per year.

3.03 Weather systems moving across the nation largely determine Cedar River's day to day weather. These systems make the weather highly variable, changing often and quickly.

3.04 The highest temperature recorded at nearby Escanaba was 100°F and the lowest was -32°. The average July temperature is a moderate 66° and the January and February average is 15°. Nearby Fayette-Sack Bay has an average frost free growing season of 140 days. The average date of the last freeze is May 19 and the average first freeze in the Fall is October 6. The annual percent of possible sunshine averages 50%, varying between 67% in July to 27% in November and December (4).

3.05 Precipitation is well distributed throughout the year with an annual average of 29.5 inches in Escanaba. June, July, August, and September each

receive an average of 3.3 inches and the dryest months, January and February, each receive an average of 1.4 inches. Snowfall averages 58.0 inches annually with about 112 days per season with one inch or more of snow on the ground.

3.06 Because of the very low population density and lack of manufacturing concerns in the nearby area, air quality is very good in the Cedar River vicinity. This is based on Michigan Air Quality Report for nearby Menominee in 1978 (26).

Geology

3.07 The Cedar River area is located near the northwestern edge of the "Michigan Basin" geologic formation. This formation is comprised of Paleozoic sedimentary rocks that dip to a low point in central lower Michigan (5). The younger rock is found in the center of the basin while the older is found near the edge.

3.08 Dolomite of the Ordovician period is found 25 to 40 feet below the surface in the Cedar River area. Dolomite, a compact limestone rich in magnesium, is used in building and construction. Mining of this material is important in some Upper Peninsula areas.

Topography

3.09 The Cedar River area has generally low relief and poor drainage. Much of the area is low and wet with water at or near the surface for much of the year. Local relief is only about 20 feet with gentle grades throughout.

3.10 Northeast of the river mouth lies a large mound more than 15 feet high, with a surface area of about 1.5 acres. There is no significance to the mound other than it is an unusual feature thought to be an old (about 100 years) abandoned sawdust pile from the lumbering days. The mound and general topography are shown in Figure III.

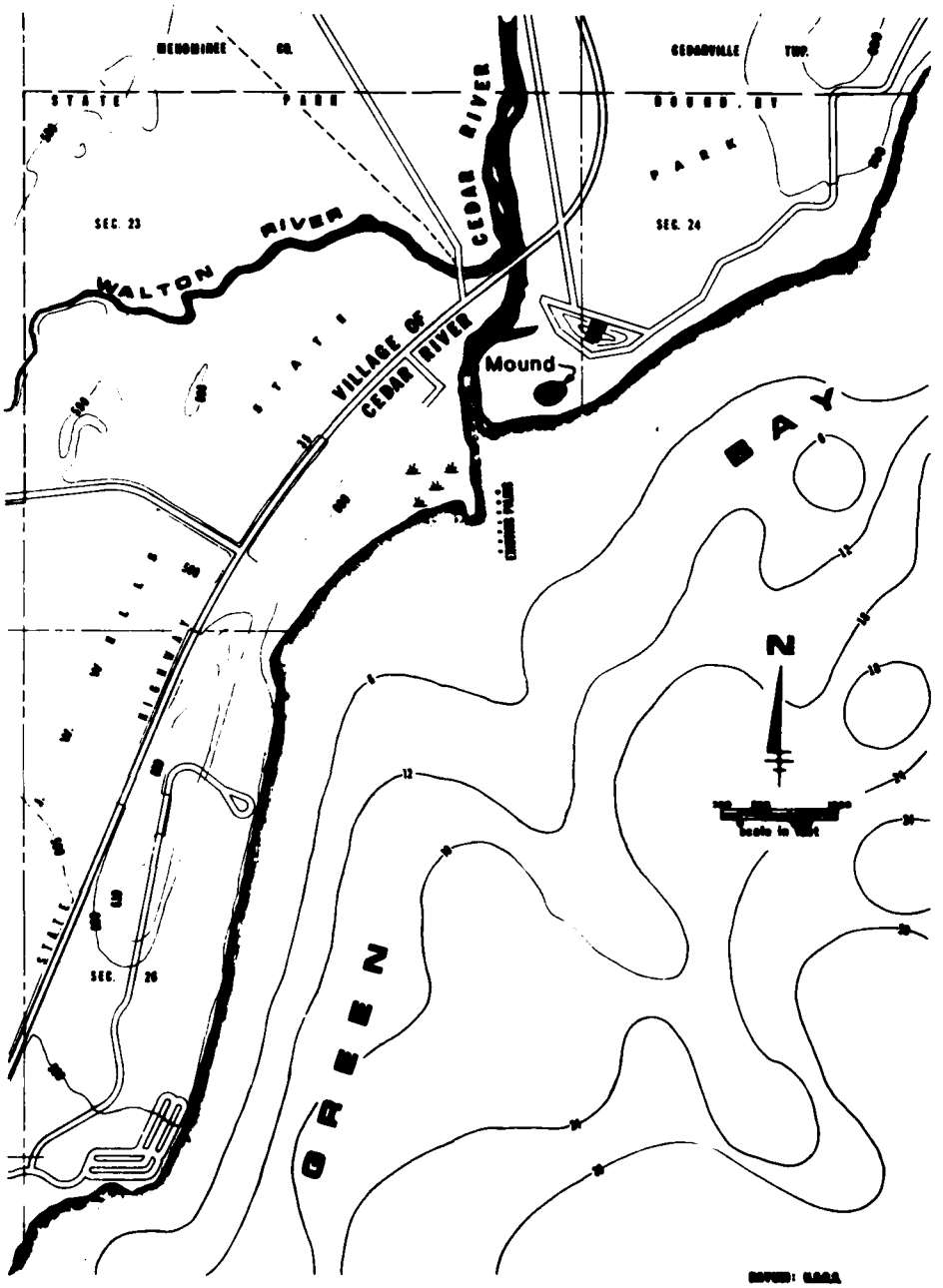


FIGURE 2E

EXISTING CONDITIONS

Soils

3.11 The soils of the Cedar River vicinity are characterized as wet upland soils (6). General mapped information shows the area to be dominated by the Roscommon-Tawas-Angelica Soil Association. This Association has deep, nearly level subsoils and very poorly drained organic soils. Residential and recreational restrictions on this soil type are listed as "severe" because of its wetness and organic content. Suitability for agricultural uses are listed as "poor" to "fair". Erosion potential of disturbed soils in this association is also great.

3.12 Sediment samples were taken in January, 1978, and analyzed for a variety of parameters (27). The sediments in the river were shown to be generally clean beach sand with no visible oil or grease, and no detectable odor. A small amount of wood, sawdust, and bark was noted in two of the River samples.

3.13 The core sample taken from the lake area east of the river mouth contained about 4 inches of wood chips sandwiched between layers of sand. The decaying wood gave off a hydrogen sulfide odor. Chemical analysis of the sample, however, showed no unusual concentration of contaminants. The sawdust layer probably remains from the saw mills once located nearby.

3.14 Chemical analysis of the sediments and elutriate (wash water) shows generally low concentrations of toxic materials (27). All of the samples meet or exceed conformance with accepted sediment quality standards (EPA letter page G-53).

Hydrology

1. Surface Water

3.15 Lake Michigan (Green Bay), the Cedar River, and the Walton Creek are the major surface waters in the area. The water level of Lake Michigan can vary several feet depending on long term precipitation patterns, seasonal precipitation patterns, and short-term weather characteristics. The

greatest long term fluctuation recorded is 5.6 feet (2). Seasonal variation averages about one foot. Short-period fluctuations, caused by temporary weather disturbances and lasting only a few hours, can be as much as 8 feet (1).

3.16 Littoral drift patterns are not well defined for the Cedar River area (8) although it is thought that the drift material comes primarily from the northeast. It is reported that the river mouth area has experienced increased shoaling in recent years decreasing the water depth to about 5 feet. This shoaling apparently did not take place when the east pier was structurally sound.

3.17 The Cedar River is a medium sized river about 50 miles long which drains some 350 square miles. It empties into Lake Michigan at the Village of Cedar River. Flows are highly variable and indicate a high runoff situation in the watershed; i.e. shallow and/or impervious soils, high water table, etc. Flow data is not presently available for the Cedar River.

3.18 Walton Creek is a major tributary to the Cedar River, joining it only a few hundred feet from its mouth. The Creek is about 20 miles long and drains a large area to the west of Cedar River. Flow data is not available for the Creek.

3.19 Flood elevation of the Cedar River area is controlled by Green Bay. The 100-year flood elevation for Green Bay is 584.4 (U.S.G.S. Datum) (7). This is about 4.8 feet above the 75-year average of 579.6 feet. Wave runup has been estimated at an additional six feet. The Cedar River does not normally receive enough runoff to overflow its banks, and flooding by this source is almost unknown.

2. Groundwater

3.20 Groundwater is restricted to a shallow area between bedrock and land surface (about 25 to 40 feet). Because of this restricted area, low relief,

and generally heavy soils, groundwater is usually close to the surface and probably moves slowly to the southeast eventually reaching the Lake. Domestic wells are generally drilled through the top layer of sand (2-10 feet), through the clay layer (10-20 feet) and developed in the upper bedrock. Most of these wells are of good quality and are good producers for domestic use (about 20 gallons/min). There are no reported well contamination problems in the Cedar River area.

Wetlands

3.21 Wetlands are defined as areas inundated by water for a sufficient period of the year so that wetland vegetation becomes dominant. The immediate area on either side (J. W. Wells State Park) of the river mouth is state owned land, and contains wetlands. These two small wetlands (24 acres-Fig. II) contain a variety of wetland plants (see par. 3.231). The drainage basin of Cedar River has many wetland areas, in particular cedar bogs.

Water Quality

3.22 The water quality of both the River and the Lake appears to be very good. Samples were taken on January 25, 1978 and analyzed for a variety of parameters (27). The iron content and the dissolved solids fraction of the river samples were somewhat high, but not unusually so considering the mid-winter condition.

Vegetation

3.23 The forests of the Cedar River area are primarily white cedar (Thuja occidentalis), spruce (Picea sp.), birch (Betula sp.), and aspen (Populus sp.). Some hardwoods also grow along the river: sugar maple (Acer saccharum), black ash (Fraxinus nigra), and beech (Fagus grandifolia). Dogwood (Cornus sp.), speckled (tag) alder (Alnus incana) and other woody shrubs grow in the more open areas.

3.231 The two small (24 total acres) wetlands on either side of the river mouth (Figure II) are basically Type 3 (Circular 39 - Fish & Wildlife Source) or inland shallow fresh marshes. Common plants include cattail (Typha

latifolia), burreed (Sparganium sp.), woolgrass (Scripus cyperinus) rush (Juncus effusus), sedge (Carex sp.), duckweed (Lemna sp.), dogwood (Cornus stolonifera), and alder (Alnus rugosa).

Wildlife

3.24 Mammals known to frequent the immediate Cedar River vicinity include deer (Odocoileus virginianus), red squirrel (Tamiasciurus sp.), and snowshoe hare (Lepus americanus). Other small mammals are thought to be present although none were observed during this investigation.

3.25 The birds that frequent the area are principally migratory in nature. Bufflehead (Bucephala albeola) and goldeneye (Bucephala clangula) are reported to use the sheltered river mouth area during the spring and fall waterfowl migrations. Merganser ducks (Mergus merganses) also use the area as a feeding ground particularly during the spring smelt run (9). Shore birds are also common along the lake during low water years.

Threatened or Endangered Species

3.26 A field reconnaissance was conducted of the vicinity to locate any possible threatened or endangered species. In response to the U.S. Fish and Wildlife Service letter, dated May 14, 1979 (see pg. G-54), the following results were noted:

3.27 A review of the Federal (Red Book) and State Endangered Species Lists reveals that the Cedar River area habitat is not generally suitable for most of the known endangered plant species (10). Endangered plant species that may be found in habitat similar to that of the Cedar River area are (18):

Monkey-flower Figwort	Mimulus glabratus
Dwarf Lake Iris	Iris lacustris
Pondweed	Potamogeton hillii

No individuals of these species have been reported from the Cedar River vicinity (9), nor were any noted during field reconnaissance.

3.28 Michigan's endangered species list (18) indicates that several rare mammals could be located in the southwestern portion of the upper peninsula.

These species are: the pine marten (Martes americana), the Arctic shrew (Sorex arciteus), the Water shrew (Sorex palustris), Hoy's pigmy shrew (Microsorex hoyi), the badger (Taxidea taxus), and the Canada lynx (Lynx canadensis). No populations of these species are known to exist in the immediate Cedar River area. The only mammal classified as endangered in the area is the Eastern timber wolf (Canis lupus lycaon) reported to populate the area several miles northeast of Cedar River.

3.29 One threatened bird that is known to use the general area is the bald eagle (Haliaeetus leucocephalus). A reoccupied nesting site is located about 5 miles northeast (although no species have been reported in recent years) area: the marsh hawk (Circus cyaneus), the osprey (Pandion haliaetus), the black-crowned night heron (Nycticorax nycticorax), American Peregrine Falcon (End.) (Falco perigrinus anatum), and Artic Peregrine Falcon (End.) (Falco perigrinus tundrius).

3.291 Several rare fish and reptile species, and one unusual invertebrate species(Table G-2)could be in the Cedar River region, although none of these species have been found there to date.

TABLE G-2

UNUSUAL SPECIES OF THE UPPER LAKE MICHIGAN BASIN

Common Name	Scientific Name	Classification (State)
Longjaw cisco	Coregonus alpenae	Endangered
Deepwater cisco	Coregonus johannae	Endangered
Blackfin cisco	Coregonus nigripinnis	Endangered
Shortnose cisco	Coregonus reighardi	Endangered
Lake sturgeon	Acipenser fulvescens	Threatened
Lake herring	Coregonus artedii	Threatened
Bloater	Coregonus hoyi	Threatened
Kiyi	Coregonus kiyi	Threatened
	REPTILE	
Five-lined skink	Eumeces fasciatus	Rare
Wood Turtle	Clemmys insculpta	Rare
	MOLLUSK	
(No common Name)	Elliptio complanatus	Threatened

3.30 All of the above named fish species, except the sturgeon, are deep water fish not normally found in water less than 40 feet deep. It is unlikely that these species would be found in the immediate vicinity of Cedar River. The lake sturgeon is found in certain rivers draining into Lake Michigan; however, there is no record of a sturgeon fishery at Cedar River. The nearest known sturgeon populations are in the Menominee River about 30 miles to the Southwest.

Fisheries and Aquatic Ecosystems

3.31 The existing and potential fisheries is of great concern to the Cedar River area. Commercial fishing has been a major income source for the community for several years. Five boats have been operating out of the River and total 4 to 5 million pounds of alewife production per year. In addition to the alewife production (made principally into pet food), the fishermen collect about 750,000 pounds of smelt and 70,000 pounds of whitefish (11). These fish are trucked to nearby Stephenson for processing. The commercial fishery brings approximately $1,000,000 to the area annually.

3.32 Sport fishing is also an important "industry" for the area. Most of the fishing takes place in the river for river running salmon, trout, suckers, and smelt. The offshore fishery is not well utilized by the sportsmen even though brown trout and whitefish are known to frequent the river mouth area.

3.33 Benthic samples were taken as a part of the January 25, 1979 sediment analysis but at all four sampling stations, no macro-benthos was found (12). This is probably due to drifting nature of the bottom material, little organic matter on the bottom, and the time of year the samples were taken.

3.34 A study of the major aquatic species in Cedar River has not been made although good diversity would be expected due to the high water quality of the River. It is noted that the sea lamprey (Petromyzon marinus) does populate the River. Treatments are made on a 2 or 3 year basis by the Fish and Wildlife Service to help control this parasite.

3.35 The migratory fish that move up the River to spawn include (13):

Brook Trout	Salvelinus fontinalis
Brown Trout	Salmo trutta
White Sucker	Catostomus commersoni
Longnose Sucker	Catostomus catostomus
Coho Salmon	Oncorhynchus kisutch
Steelhead Trout	Salmo gairdneri
Rainbow Smelt	Osmerus mordax

3.36 The majority of the spawning and migratory activity is during the early spring and in the fall. Activity is much reduced during mid-summer and almost no movement has been noted during ice cover.

3.37 Whitefish are common in the Lake and River mouth area although there is no evidence that they use the area for reproduction. It is thought that most of the whitefish spawning activity takes place farther north (20).

Man Made Facilities and Services

3.38 As noted earlier, (Paragraph 2.09), the remains of the original pier still exists to some degree on the east side of the River. On the west side of the River is a short pier of wood construction and a navigation light (See Figure II). Upstream, about 2000 feet from the River mouth, is the highway bridge. This structure limits the navigation of larger boats to the River mouth area. A public boat ramp is located on the east side of the River just downstream from the bridge.

3.39 The Village of Cedar River is a small, unincorporated hamlet located just west of the River. It is service oriented with two gas stations, two restaurants, two taverns, and a general store. About two miles west of the River is the campground of the J. W. Wells State Park.

3.40 Transportation to Cedar River is by automobile via Highway 35 or by boat. At present, recreational boaters are reluctant to traverse the northwest shore of Green Bay between the Cities of Escanaba and Menominee because no deep draft harbor of refuge presently exists along that area.

Demography and Social Characteristics

3.41 Cedar River and the surrounding area is sparsely settled with minimum local employment. Most working residents commute to the Cities of Escanaba or Menominee to work. At a local level, fishing, lumbering, and retail services employ most of the people. There are also a few farms inland.

3.42 The population of Cedarville Township in 1975 was estimated at 271 with the total for the County estimated at 25,376 (14). It is projected that the Township's permanent population will about double by the year 2000. During the summer season, the population increases substantially as people fill the resorts, cabins, and campgrounds in the Township.

3.43 Tourists are attracted to the Cedar River area for a variety of reasons. Fishing is a major activity enjoyed by the visiting public. Hunting for deer, grouse, and duck are activities prevalent in autumn. Aesthetics, uncrowded conditions, and a large amount of public land also help draw vacationers and sportsmen to the area.

Historical, Archaeological and Cultural Resources

3.44 A review of the National Register of Historic Places (15) showed no National Historical sites in the Cedar River area. The State Historic Preservation Officer has also been contacted and has determined that the proposed project would have no effect on significant cultural resources (page G-61).

3.45 The mixture of thick forests, open fields, rivers, lakes, and shoreline make the area aesthetically very pleasing.

Recreation

3.46 Local recreational resources include: a boat launching ramp, J. W. Wells State Park, cross country ski trails, lake and stream fishing, and large areas of public land. Fishing, camping, and hunting are probably the major recreational activities in the area. Boating is also an important activity. About a dozen seasonal permits are issued by the State Park for anchoring in the River. Daily use is estimated at 40 to 50 boats on peak days (16). Most of these boats are shallow draft fishing boats. Fishing is heavy from spring through early fall.

SECTION 4
ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED PROJECT AND ALTERNATIVES.
CONSEQUENCES OF THE PROPOSED PROJECT

Hydrology

4.01 The proposed construction would have little or no impact on the flooding potential of the area since neither the stream flows nor the Lake level would be influenced.

4.02 Littoral drift and the deposition of sediments would be influenced by the construction. A small buildup of coarse sand and drift materials is expected on the east side of the pier as wave and current energy is dissipated against the new structure. Some shoaling at the end of the pier is also expected although pier design would mitigate this problem to some extent. The utilization of proper pier length and angle would maximize use of the river current to keep the pier entrance free of drift materials. A deeper dredging elevation at the harbor entrance may also be used to create a "settling basin". This would reduce the maintenance dredging and receive the first year's slough material.

Wetlands

4.03 The proposed project would have no immediate impact on the wetlands located adjacent to the river mouth or inland as construction and use would be largely limited to the lake and river area. The shallow lake area on either side of the river mouth would become even more shallow due to drift deposition and the disposal of beach nourishment materials. The adverse impacts are expected to be minimal as there is presently little utilization of this area by plant life, benthos, fur bearers, and shore birds. This area may, in fact, produce more of the above mentioned life as it becomes shallow and more protected.

Water Quality

4.04 Water quality is not expected to be influenced by the project except on a temporary basis during construction. Construction equipment would disturb the bottom materials during dredging and filling; however, impact is expected to be very local due to the coarse nature and rapid settling of these materials. Use of appropriate dredging equipment should be maximized, thus reducing siltation of the water. Some minor gasoline spillage and exhaust may also be noted during construction.

4.05 Construction of docking facilities later by the Michigan DNR would also cause a temporary water degradation due to construction engendered turbidity. Although the area is currently used by recreational boat craft, an increase in boating use is expected. Due to this increased useage, there can be expected a decrease in the local water quality. However, because of the Cedar River flow, stagnant conditions would not develop. In addition, the state would provide necessary trash containers and pump out facilities.

Vegetation

4.06 Little, if any, impact is expected on the terrestrial or aquatic plant communities. Little construction activity would take place on the shore and only minor impact is expected.

4.07 The two small wetlands (24 acres) shown on Figure II are expected to remain undisturbed. There is no construction within the wetlands. The construction access roads would utilize existing roadways on the periphery of these wetlands.

Wildlife

4.08 Because most of the construction would take place in the Lake or River, no immediate impact is expected to terrestrial wildlife species. Greater human use of the surrounding area is expected

but this activity would mostly be confined to the near shore area downstream from the bridge.

4.09 Migratory waterfowl and shore birds may benefit from the construction.

4.10 The reptile and amphibian populations are probably small in the river mouth area as the general habitat is unsuitable for most species. Impact on these populations is expected to be small or non-existant.

4.11 No adverse impact to any endangered species is expected.

Fisheries and Aquatic Ecosystems

4.12 No change in fish species or populations is anticipated. The new pier is not expected to interfere with the movement of migratory fish. More fish will be caught by the sport fishermen using the pier, but properly managed sport fishing does not normally hurt the overall population. The pier would also provide cover for a variety of aquatic plants and animals as well as fish that prey upon them. The proposed fishery habitat would greatly enhance the fisheries of the area.

4.13 The dredging operation may temporarily disturb fish activity in the immediate work area, however, the dredged materials are expected to settle quickly, thus minimizing this impact. Schedules for dredging and construction in the water would be coordinated with the Michigan Department of Natural Resources, the U.S. Environmental Protection Agency, and the U.S. Fish and Wildlife Service to avoid adverse effects on fish spawning and migration.

Man Made Facilities and Services

4.14 Portions of the existing wooden pier would be removed before the shorter pier alternates would be installed (See Section 2). Removal of this largely deteriorated structure should cause no adverse impacts beyond the movement and operation of heavy equipment. The suitable material would be placed offshore as underwater fishery habitat.

4.15 An increase in service facilities is anticipated following construction of the pier. As people made greater use of the recreational potential, additional eating establishments, vehicle service centers, tackle stores, and motels would be needed. These services would probably be located along the M-35 corridor and would exert some adverse impact on the natural resources of the area. Some additional land would be developed and building materials, power, water, and wastewater disposal would have to be provided.

4.151 Boating activity would increase in the harbor area as a direct result of the proposed plan. Boating safety would increase because of the following features. The new east pier would create a harbor of refuge. Corps of Engineer safety standards would be incorporated into the pier design. Deepening and widening of the channel and turning basin would improve safety. Coast Guard boating regulations would be implemented. Speed limits would be posted and navigation lights and bouys would be installed. It is anticipated that projected needs would be met.

4.16 The streets and highways of the area are considered adequate for increased use. State Highway 35 is a well maintained primary road with wide shoulders and several turnoffs. The state maintained public boat launch site offers a sizable parking area.

4.161 Emergency services (medical, police) are located from 25 to 30 miles away in the towns of Escanaba, Menominee, and Marinette. A Coast Gaurd air station in Traverse City would be able to provide the quickest emergency service in case of boating mishaps. Cedar River is about 85 miles from Traverse City. On site arrival times for fixed wing aircraft would be one half hour and for rotary wing aircraft around one hour and ten minutes. The air station has plans to receive faster rescue aircraft in 1982 and 1983 which would reduce on site arrival times to 15 minutes (fixed wing) and 45 minutes (rotary wing). All times are estimated air time. Slightly more time would be needed for notification and preparation (26).

4.17 No change in overall air quality would be expected from the increased boating and automobile traffic. With more boats, there could be an increase in noise. However this is already a utilized boating area, and any increase in boat noise would not adversely impact on existing conditions.

Demography and Social Characteristics

4.18 An increase of about double the current population (271) is anticipated without the project by the year 2000. A somewhat greater increase would be expected with the project.

4.19 The demand for additional services would increase local employment although this employment would be somewnat seasonal in nature. Construction activities would also employ local people and services for a short period of time.

Historical and Archaeological Resources

4.20 The National Register of Historic Places (15) was consulted and it was found that no national historical sites are located in the project area. Four sites are located in Menominee County, all in the City of Menominee. The proposed work would not cause any adverse effect on the properties. The project area has been reviewed by the State Historic Preservation officer. It was determined that no archaeological or cultural resources would be affected (page G-61).

Economic Activity

4.21 The proposed project would add a substantial economic basis to the Cedar River community. Increased use of the area's recreational potential would also bring dollars into the area on a more permanent basis.

4.22 The commercial fishing vessels would also return to the Cedar River area as their permanent base. They have had to dock at Menominee in recent years because of the shoaling at the River mouth. Since their base of operations has remained at Cedar River, Menominee would lose only the dockage fee.

Recreation

4.23 Recreational use of the area would increase following completion of the project. Boating, both pleasure and fishing, would increase substantially. Also, fishing from the new pier would become popular.

4.24 As people are drawn to the area for fishing and boating, they would also discover other recreational potentials. Greater use of the area's hunting, snowmobiling, cross country ski trails, etc. would probably follow.

4.25 The aesthetics of the area would not be greatly impacted except for the immediate vicinity of the pier. The pier would be an addition to the shoreline scene and the congregation of boats in the harbor would be larger than previously known. The proposed rubble pier of large rock slabs is not out of line with the scenery of the Upper Great Lakes. The congregation of multi-colored boats and their related paraphernalia could be very attractive, particularly to boating enthusiasts.

Effects of Proposed Project on Land Use Plans

4.26 No change in the type of land use would be expected due to the project, but an increase in those uses anticipated. Some increase in service oriented development would probably take place along the highway west of the River. Any increase in residential development would probably be scattered throughout the township. None of these uses are contrary to existing land use plans.

4.27 Several land use plans have been formulated that include the Cedar River region. These plans include: a state recreation plan, Regional 208 plan, County comprehensive plan, County solid waste management plan, and a township zoning ordinance. None of these plans would be affected by the proposed project.

Relationship Between Local Short-Term Use of The Environment and Long-Term Productivity

4.28 The long-term productivity of the area would be enhanced by the proposed project. The availability and safety of the harbor would lead to greater boating and recreational use of the River area. Pleasure boats would utilize the harbor as both a seasonal anchorage and as a temporary refuge for transient craft. Better use of the offshore sport fishery would follow construction of the project and the efficiency of the commercial fishery would be improved as the boats would be able to use the harbor again rather than docking at Menominee.

4.29 Because of the increased use of the area, the local economy would benefit from the project. It is expected that the use would be somewhat seasonal but the long term effect would be a more stable and dependable economy.

4.30 The short-term use of the area with the project would be the same as the above mentioned long-term use except that it would probably take a few seasons for people to learn of the improvements and utilize them to the maximum.

Irreversible and Irretrievable Commitment of Resources which would be involved in the Proposed Project should it be implemented

4.31 Material, energy, and labor would be the major resource commitments to the proposed project. The greatest activity would be during the initial construction, although periodic maintenance dredging would also be anticipated.

4.32 The rock rubble for the pier would probably be quarried from as near the site as possible. Energy would be largely in the form of petroleum products necessary to run the heavy construction and dredging equipment. The majority of the labor involved in the project would probably be contracted to private contractors.

4.33 Completion of the proposed project would largely commit the economic structure of the community to a recreation/service type orientation. Preservation of the area's scenic qualities and fisheries potential may preclude location of certain non-compatible industries in the nearby area.

4.34 The environmental impacts for the three alternatives are similar. Each alternative involves the dredging of comparable amounts of material and each would utilize this material in the same manner (beach nourishment).

TABLE G-3

SYSTEM OF ACCOUNTS - SUMMARY OF IMPACTS

ALTERNATIVE PLAN FACTORS	ALTERNATIVE 1 2100 FOOT PIER	ALTERNATIVE 2 875 FOOT PIER PROPOSED PLAN NED PLAN: EQ PLAN**	ALTERNATIVE 3 SHORT PIER	NO ACTION
1. NATIONAL ECONOMIC DEVELOPMENT				
A. Annual Project Costs	$96,820	$68,010	Not evaluated	No Cost
B. Benefit-Cost Ratio	2.55:1	3.13:1	Not evaluated	--
C. Tax Revenue*	Increased revenues from existing establishments & future developments	Same as Alt. 1	Same as Alt. 1	Revenue would continue at present rate
D. Property Values*	Some increase expected	Same as Alt. 1	Same as Alt. 1	Would remain stable
E. Public Facilities and Services*	Would increase	Same as Alt. 1	Same as Alt. 1	A slow increase is expected
F. Desirable Community Growth*	An increase in permanent growth would be anticipated	Same as Alt. 1	Same as Alt. 1	Slow growth expected
G. Desirable Regional Growth*	No anticipated effect	Same as Alt. 1	Same as Alt. 1	No effect

ALTERNATIVE PLAN FACTORS	ALTERNATIVE 1 2100 FOOT PIER	ALTERNATIVE 2 875 FOOT PIER PROPOSED PLAN NED PLAN: EQ PLAN**	ALTERNATIVE 3 SHORT PIER	NO ACTION
H. Employment/Labor Force*	An increase, although somewhat seasonal, is anticipated; temporary increase during construction	Same as Alt. 1, but less employment	Same as Alt's 1&2 but less employment	Little change for present low employment
I. Business & Industrial Activity*	Service facilities and commercial fishing activity would increase	Same as Alt. 1	Same as Alt. 1	Little change from present minimal activity
J. Displacement of Farms*	No effect	No effect	No effect	No effect
2. ENVIRONMENTAL QUALITY				
K. Man-Made Resources*	Greater use of roads, parks, boat ramps, etc., but no increase in like facilities needed immediately; use of man-made materials in construction; energy used in construction and maintenance.	Same as Alt. 1 but less use of man-made construction materials and energy	Same as Alt's 1&2 but less use of man-made construction materials and energy	Breakwater would continue to deteriorate

ALTERNATIVE PLAN FACTORS	ALTERNATIVE 1 2100 FOOT PIER	ALTERNATIVE 2 875 FOOT PIER PROPOSED PLAN NED PLAN: EQ PLAN**	ALTERNATIVE 3 SHORT PIER	NO ACTION
L. Natural Resources*	Loss of bottomland from construction of breakwater; temporary destruction of aquatic habitat from deposition of dredged material; loss of energy used in construction; rubblemound breakwater would provide a new faunal habitat.	Same as Alt. 1 but less bottomland displaced, less dredging necessary. Use of stone from from old breakwater would create a fishing reef; new faunal habitat from rubblemound breakwaters.	Same as Alt's 1&2 but least amount of displacement of Lake bottom habitat; new faunal habitat from rubblemound breakwater.	No impact
M. Flora	Possible loss of rooted aquatic plants	Same as Alt. 1 but less habitat lost	Same as Alt's 1&2 but least habitat lost	No impact
N. Fauna	Some temporary distruction of benthic habitat as a result of dredging and placement of rip rap; new rip rap would result in additional fish habitat; no primary impact expected on terrestrial life.	Same as Alt. 1 but less destruction at benthic habitat and less habitat created by breakwater; fishing reef would enhance fishery and sport fishing	Same as Alt. 1 but to a lesser magnitude	No impact

ALTERNATIVE PLAN FACTORS	ALTERNATIVE 1 2100 FOOT PIER	ALTERNATIVE 2 875 FOOT PIER PROPOSED PLAN NED PLAN: EQ PLAN**	ALTERNATIVE 3 SHORT PIER	NO ACTION
O. Air Quality*	Fumes would temporarily degrade air quality during construction.	Same as Alt. 1 but less degradation	Same as Alt's 1&2 but least degradation from construction	No change
P. Water Quality*	Some turbidity during construction; slight long term impact through increased boating usage	Same as Alt. 1 but less turbidity	Same as Alt. 1 but less turbidity	No impact
Q. Noise Pollution*	Construction noise would be temporary. Increased use of harbor would increase noise level slightly.	Same as Alt. 1	Same as Alt. 1	No effect
R. Shoaling	Periodic dredging could be necessary at end of pier after approximately 5 years.	Channel would be dredged once every two years; little erosion on either side would be expected	Same as Alt. 2, but erosion would occur on west side of river mouth.	Continued shoaling is expected; erosion would continue on west pier and river bank near river mouth.

ALTERNATIVE PLAN FACTORS	ALTERNATIVE 1 2100 FOOT PIER	ALTERNATIVE 2 875 FOOT PIER PROPOSED PLAN NED PLAN: EQ PLAN**	ALTERNATIVE 3 SHORT PIER	NO ACTION
3. SOCIAL EFFECTS				
S. Displacement of People*	No effect.	No effect.	No effect.	No effect.
T. Recreation	Recreational opportunities would be greatly enhanced; substantial use increase of harbor; use of breakwater for fishing.	Same as Alt. 1	Same as Alt. 1	A gradual increase is anticipated, deterioration of breakwaters would inhibit recreational use of water resources.
U. Community Cohesion*	Has local support; would give the community a more stable economic base.	Same as Alt. 1	Same as Alt. 1	Use of harbor by commercial fishermen may further decline.
V. Transportation	Increase in auto traffic & boating activity.	Same as Alt. 1	Same as Alt. 1	No change
W. Historic/ Archaeological Resources	No effect; there are no known archaeological resources in the project area.	Same as Alt. 1	Same as Alt. 1	No impact

ALTERNATIVE PLAN FACTORS	ALTERNATIVE 1 2100 FOOT PIER	ALTERNATIVE 2 875 FOOT PIER PROPOSED PLAN NED PLAN: EQ PLAN**	ALTERNATIVE 3 SHORT PIER	NO ACTION
X. Aesthetics*	Construction activity would produce temporary negative effects; breakwater would be an additional structure on the shoreline; use of native materials would enhance the appearance of the project.	Same as Alt. 1 but breakwater would be less obtrusive.	Same as Alt's 1&2 but breakwater would be less obstrusive.	Old breakwater would remain and continue to deteriorate and become more unsightly.
Y. Public Health*	Harbor of refuge will increase boating safety along North Shore of Green Bay.	Same as Alt. 1	Same as Alt. 1	Shallow water at river mouth is presently a boating hazard; adequate refuge would not be provided; deterioration of breakwaters would become more of a boating hazard.

* Item required by Section 122, Public Law 91-611, River and Harbor Flood Control Act of 1970.

** The NED (National Economic Development) Plan is that plan which is most desirable economically. The EQ (Environmental Quality) Plan is that plan which makes the greatest positive contribution to the EQ Account. See also paragraph 14, Supplemental Report.

SECTION 5

PUBLIC INVOLVEMENT

Public Involvement Program

5.01 After renewed interest in the project on the part of the local sponsor, the Michigan Department of Natural Resources, approval of a revised design and reconfirmation of the local assurances were obtained for the project. Subsequently,coordination was continued with U.S. Environmental Protection Agency, U.S. Fish and Wildlife Services, Michigan Department of Natural Resources, and the Michigan State Historic Preservation Officer with respect to disposal of dredged material, and potential project impacts on the natural and cultural environment. A public meeting was held 6 December 1979 at Cedar River to present the proposed new design. Corps staff, representatives of the Michigan DNR, U.S. Fish and Wildlife Service and the consulting engineer, and local fishermen and businessmen attended. Ninety people from the area attended the meeting. On 18 July 1979, a meeting was held in Lansing between the Corps, Michigan DNR, U.S. Fish and Wildlife Service, and the consulting engineer to review the status and details of the project.

Required Coordination

5.02 The revised project plans have been reviewed by the Michigan DNR, U.S. EPA, U.S. Fish and Wildlife Service, U.S. Coast Guard, and Michigan State Historic Preservation Officer. Copies of correspondence received will be found in Section 8 , Correspondence with Agencies. Coordination will continue through circulation of the Draft and Final Environmental Impact Statements and Preliminary and Final Section 404 Evaluations.

Statement of Recipients

5.03 A list of recipients of the DEIS will be found in Section 6 of the EIS.

Public Views and Responses

5.04 Coordination with the U.S. Fish and Wildlife Service resulted in a request that the old pier be left in place to enhance fishing habitat where it extended beyond the new one. This was unacceptable to the U.S. Coast Guard, however, since the ruins would constitute a hazard to navigation. It was then decided to attempt to use the rock material from the pier as underwater fishery habitat to be built with at least 10-12 feet of clearance from the low water datum line. The Michigan Department of Natural Resources has recommended placing the material between the 15 and 20 foot contour about half a mile south of the harbor in two or three piles six feet high, (see Section 8, page G-64).

5.05 The Michigan Department of Natural Resources also wanted to eliminate dredging past the turning basin (MDNR letter, Section 9). Original dredging plans have been altered in consideration of this proposal. Dredging would be done only up to the end of the turning basin.

SECTION 6
LIST OF AGENCIES, ORGANIZATIONS AND PERSONS
TO WHOM COPIES OF THIS STATEMENT WERE SENT

Honorable Donald W. Riegle

Honorable Carl Levin

Honorable Robert W. Davis

U.S. Dept. of Agriculture

Dept. of Health, Educ. & Welfare

Federal Energy Regulatory Commission

Sidney Galler, Dep Asst Sec/Env Affrs, U.S. Dept. of Commerce

Advisory Council on Historic Perserv

Loren A. Wittner

Fish & Wildlife Service

Regional Director (AE/OBS)
U.S. Fish & Wildlife Service

Director, Ofc of Env Project Review
Dept of the Interior

Director, Environmental Impact Division, Federal Energy Regulatory Commission

Office of Environmental Review
Michigan Dept. Natural Resources

Environmental Protection Agency

Director, Ofc of Federal Activities
Environmental Protection Agency
(A-104)

Michigan Department of State
State Historic Preservation Officer

State of Michigan, Dept. of Education State Library Services

Exec Ofc of Gov/Planning Coord.

Mr. Terry L. Yonker, Exec Sec, Mich. Env. Review Bd, Dept of Management and Budget

Michigan Dept. Highways & Transportation

Adv. Council for Environmental Quality

State Conservationlist, U.S. Dept of Agriculture, Soil Con Sv.

Michigan Dept. of Commerce
Michigan Waterways Commission

Sec., Conf. of Mich. Archaeology
The Museum/M.S.U.

Michigan United Conservation Clubs

Michigan Natural Areas Council

League of Women Voters

Mr. Arthur L. Carpenter
Michigan Audubon Society

Mr. James Harter, Manager
J.W. Wells State Park

Mr. Louis Ruleau

Mr. Edward Vitort

H. Paul Friesema

Mr. David A. Dishneau

Detroit Public Library, Book Selec. Dept.

Mr. Dan Spalink
Izaak Walton League

Mr. Larry Witte, Ch, Water Mgmt Divn
Michigan Department of Natural Resources

Mr. Karl R. Hosford, Ch, Divn Land Res, Michigan Department of Natural Resources

Weather Service/Michigan Department of Agriculture

Detroit Free Press (Attn: Tom Opre)

Dept. of Housing & Urban Development

Detroit Boatyard

Joseph S. Mack

Honorable Jack L. Gingrass

Mimi Becker, President
Great Lakes Tomorrow

Dept. of Health Education & Welfare
Public Health Service, Center for Disease Control

LIBRARIES
U.S. Govt. Printing Office
Public Document Warehouse

U.S. Forest Service

Ms. Rita Meyninger, Regional Director, Federal Emergency Management Agency

Colorado State University
ATTN: Fred Schmidt

Wildlife Management Institute's
North Central Office

U.S. Department of Transportation

Chief, Grand Haven Area Office
Detroit District Corps of Engineers

Mr. George J. Shimek
Supervisor East Bay Township

Mr. Irving D. Anderson

Michigan Natural Areas Council

Mr. Edward Sienkiewicz
Michigan Duck Hunters Association

Mr. Jay B. Reed, Representative
National Audubon Society

Mr. John Vallerulo

Mr. Sam Dragic

Mr. James E. Vetrot

Mr. Joseph Buyarski

Mr. Arthur L. Klawiter
DNR-Waterways

Mr. Gayle V. Crabb
Corps of Engineers-St. Marys Falls Canal

Mr. Richard Pavlat Sr.

Mr. Nash James

Mr. Kenneth Gronmark

Mr. & Mrs. Karl Kranberl

Mr. Ernest Sunila

Mr. Earl Gustafson

Mr. Marvin Zettel

Mr. & Mrs. Robert Diehm

Mr. Brian C. Wood
Escanaba Yacht Club

Mr. Gene Kauffman

Mr. Nick Diehm

Mr. John Nelson

Mr. David Bonczyk

Mr. John Gromalm

Mr. William Weinschrott

Mr. Matt Weinschrott

Mildred Weinschrott

Mrs. Stephen Feigerle

Mr. Jimmie Lynch

Mr. Edward Betort

Mr. Herbert Bauer

Mr. John E. Mark

Anne E. LaBay

Mr. Jim Bogema

Mr. James M. Hooker

Mr. Arthur T. Pope

Mr. Tom Ford

Mr. Stephen J. Kakuk

Mr. Robert Ruleau

Mr. Harry C. Westrich

Mr. Roy C. Hubbard

Mr. Herbert W. Casey

Mr. Walter Jozaitis

D. J. Shipman-GBYA Escanaba Yacht Club

Mr. Roy Kemink

D.F. Quinn

Mr. John A. Manning

Mr. Richard J. Anderson

C. P. Anderson

Mr. Claude Schmitt-DNR

Mr. Clifford Hayward

Mr. Ted Peterson

Norbert J. Hayward

Francis Hayward

Mrs. Betty Bolen

Mr. Thomas Bolen

Mr. Roy A. Hubbard

James & Kathy McMonigal

Mr. George Stich

Mr. Richard Sawyer

Dale E. Isaacson

Mr. Joel T. Phillipps

Mr. Don R. Sorensen

Indiana University
School of Public & Environmental Affairs

COMMENTS AND RESPONSES ON THE
DRAFT ENVIRONMENTAL IMPACT STATEMENT

Table of Contents

Comments and Responses - Pertinent correspondence which outlines the development of the project is contained in Section 8. The Draft Environmental Statement was sent to Government agencies (State and local) as well as interest groups and private citizens requesting their views and comments. Copies of letters received can be found in Section 9.

FEDERAL AGENCIES

A. United States Department of the Interior

1. Comment: Boating activity can be expected to increase (in the Cedar River area) as a result of improved harbor and channel conditions, so the necessity for emergency services could also be expected to increase. The statement should discuss boaters' safety relative to increased activity, the extent to which current emergency services are available, and whether projected needs can be met. Information such as emergency service locations, types of services provided, and estimates of "on-site arrival times" should be given.

Response: The towns of Escanaba and Menominee, Michigan, and Marinette, Wisconsin, have the closest emergency medical facilities and law enforcement units (state police and sheriffs) to Cedar River. These facilities are 25-30 miles away. A Coast Guard air station in Traverse City could provide emergency services for boating mishaps. Estimated on site arrival time for fixed wing aircraft operating out of the Traverse City air station to Cedar River (85 miles away) would be one half hour. Rotary wing aircraft could arrive in a little over an hour. In 1982 and 1983 the airstation expects to receive new rescue jet aircraft with a 15 minute on site arrival time and a rotary wing aircraft with a 40-45 minute arrival time (26). Corps of Engineers safety standards would be incorporated into the breakwater design. A light would be built at the head of the proposed east pier as an aid to navigation.

2. Comment: The Heritage Conservation and Recreation Service has provided Land and Water Conservation Fund (LWCF) assistance for J. W. Wells State Park. The assisted area is located immediately to the west of the proposed project but would appear not to be adversely affected. However, should land from the site be converted to other than public outdoor recreation uses, a Section 6(f) conflict would result. Section 6(f) of the Land Water Conservation Fund Act states:

> "No property acquired or developed with assistance under this section shall, without the approval of the Secretary, be converted to other than public outdoor recreation uses. The Secretary shall approve such conversion only if he finds it to be in accord with the then existing comprehensive statewide outdoor recreation plan and only upon such conditions as he deems necessary to assure the substitution of other recreation properties of at least equal fair market value and of reasonably equivalent usefulness and location."

Response: No conversion from public outdoor recreation use is planned.

3. Comment: No significant adverse effects on fish and wildlife resources or their habitats are expected to result from the presently proposed work.

Response: Your comment has been noted.

B. United States Environmental Protection Agency

1. Comment: We have completed our review of the Draft Environmental Impact Statement (EIS) and General Design Memorandum on the proposed Recreational Boat Harbor at Cedar River, Michigan. It is our understanding that the authorized project consists of pier construction, entrance and inner channel dredging, turning basin dredging, removal of an old pier, and shoreline enhancement using clean dredged material. Alternatives to the project consist of the no-action alternative and alternative designs for the pier.

Based on the information provided in the documents mentioned above, we believe the proposed action and its alternatives will have only minor adverse effects on the environment. The proposed action (Alternative 2 - 875 ft. straight pier) appears to maximize navigational benefits without significantly impacting the surrounding environment; thus, we have no objections to the proposed action.

Since we have no specific comments to offer on the proposed activities, we are classifying the Draft EIS as LO-1. This means we lack objections to the environmental impacts associated with the project, and the environmental statement adquately identifies these impacts. In accordance with U.S. Environmental Protection Agency procedures, our classification of this project will be published in the Federal Register.

Response: Your comments have been noted.

C. United States Department of Agriculture

1. *Comment:* We agree that this project would cause little if any adverse impact on upland or wetland vegetation.

Response: Your comment has been noted.

D. United States Department of Commerce - The Assistant Secretary for Productivity, Technology, and Innovation.

NOAA - National Ocean Survey

1. Comment: The subject statement has been reviewed within the areas of the National Ocean Survey's (NOS) responsibility and expertise, and in terms of the impact of the proposed action on NOS activities and projects. The National Ocean Survey found Appendix B - Hydraulic Analysis to be extremely thorough, accurate, and more than adequate for the proposed project.

Response: Your comment has been noted.

NOAA - Environmental Research Laboratories

2. Comment:

a. Restoration of Cedar River Harbor piers and deepening of channel for small craft navigation will increase boat traffic and will have a negative impact on water quality. It is estimated that most of the impact will be limited to the harbor are and the long-term effect on Green Bay environment will remain minor.

b. Wider and deeper entrance channel will allow larger waves to move into the harbor area.

Response:

a. This is true and reference to these topics is made on pages G-20 and 23.

b. A wider and deeper entrance channel would allow slightly larger waves to move into the channel. However, because of the orientation and configuration of the harbor to the channel and the length of the channel, waves would be refracted and wave energy dissipated substantially before reaching the harbor. The design wave in the harbor should not exceed 1 foot (see page B-7).

Comment: Impact Statement indicates that the section of shoreline north and south of the Cedar River appears to be in an equilibrium state as indicated in aerial photographs (page B-8). Therefore, the net volume of littoral drift south of the river calculated as 138,931 cubic yards in 1975 is not realistic. Data on water level changes in Green Bay and Lake Michigan given on pages B-1 and G-10 require verification and coordination.

Response: The 138,931 cubic yards of littoral drift was estimated from wave energy and not from a measured quantity. Elevations before 1900 were measured at a time when water levels were higher than present conditions. The long term fluctuations on page G-11 are from 1900 through December 1978 at Harbor Beach. Page G-11 discusses the greatest long term fluctuation and page B-1 discusses the greatest annual fluctuation.

E. Department of Health, Education, and Welfare

1. Comment: We have reviewed the Revisions to General Design Memorandum No. 1 and Draft Environmental Impact Statement (EIS) for the Recreational Boat Harbor, Cedar River, Michigan. We are responding on behalf of the Public Health Service.

We anticipate no adverse health impact resulting from the improvements described. However, we suggest the final EIS briefly address the following issues mentioned in the General Design Memorandum.

Reference is made on page 18 to provision and maintenance of necessary mooring facilities and utilities, including public landings or wharfs, with provision for potable water and for the sale of motor fuel, lubricants, and a parking lot with adequate sanitary facilities. The final EIS should expound upon these anticipated facilities, identifying type of water treatment, restroom and waste disposal facilities, safety around the fueling stations, and potential impacts regarding these facilities.

Response: A septic tank/drain field would facilitate disposal from a toilet/shower facility which would be built near the mooring area. The County Health Department would conduct percolation tests and issue appropriate permits for these facilities before construction. All potable water would be obtained from wells. Fire extinguishers would provide for safety around the fueling stations. All facilities would be built in accordance with the Michigan State Department of Health regulations.

F. United States Department of Transportation

1. Comment: Supplement No. 1 to the General Design Memorandum and Draft Environmental Impact Statement for the Recreational Boat Harbor at Cedar River, Michigan has been reviewed and we have no comments to offer on the statement. The proposed action will not adversely affect the existing Federal-aid routes in the area.

Response: Your comment has been noted.

G. Federal Energy Regulatory Commission

1. Comment: Because the above-noted proposed development would not pose a major obstacle to the construction or operation of facilities (hydroelectric and natural gas) and because the Draft does not indicate that existing natural gas or hydroelectric developments would be adversely affected, we make no specific comments.

These comments are of this office and therefore do not necessarily represent the views of the Federal Energy Regulatory Commission.

Response: Your comments have been noted.

STATE AGENCIES

A. Michigan Department of Natural Resources

1. Comment: Property easements at the mouth of the river may be difficult to obtain. These lands were gifts to the state and some deeds contain reverter clauses which prohibit all but park uses of these lands. A precise survey of the actual work site may reveal that the project area is not subject to these reverter clauses. A copy of the deed to the site is enclosed for your convenience.

Response: Before project implementation, an agreement with the local sponsoring agent (State of Michigan) must be entered into to provide the required real estate. Without such an agreement, the project cannot be implemented. The local sponsoring agent has the responsibility to attain the property easements and must "provide all lands, easements and rights-of-way required for the construction and subsequent maintenance of the project", (page 17 of Main Report).

2. Comment: It is likely that the dredged materials will contain organic matter, including old stumps and logs. We cannot permit the disposal of stumps and logs on the beach nourishment unless the problems of turbidity and visual appeal are adequately addressed.

Response: According to the sediment data the material does not contain stumps and logs, but "unpolluted sand suitable for beach nourishment," (see page G-53, EPA letter). However, if logs or stumps are encountered, they would not be placed at the beach nourishment area. (See page G-5, para. 2.07)

3. Comment: The project's impact on littoral processes is admittedly uncertain due to the lack of appropriate data. Since the shoreline is now believed to be in an equilibrium condition (page 15), the potential effects of the harbor structures should be addressed. We suggest that future aerial photographs be used to monitor littoral movements so that any problems that arise can receive prompt mitigative measures.

Response: The structures themselves would not significantly interfere with littoral movement. A more detailed discussion of this subject is contained on page B-8 of the main report. Aerial photographs would be useful to measure changes of the harbor. There are points of land on both sides of the harbor which collect littoral drift material. The old aerial photographs showed no significant changes.

4. Comment: Finally, we recommend that the Cedar River be dredged no further than the turning basin, unless extending the dredged area beyond the turning basin to the State Highway M-35 bridge can be justified. We cannot endorse any dredging activity unless it can be justified and provides a net benefit to the environment and the public trust.

Response: Plans for dredging have been changed in consideration of these proposals. Dredging would take place only to the end of the turning basin.

SECTION 7
[illegible] 404 Evaluation
Recreational Boat Harbor
Cedar River, Michigan

1. INTRODUCTION

The State of Michigan has asked the U.S. Army Corps of Engineers to investigate small craft harbor improvements at Cedar River, Menominee County, Michigan. Currently, at Cedar River Harbor, there are only remnants of the old east pier existing. The west pier is in a state of disrepair. Shoaling at the mouth of the river has reduced water depth and made it hazardous for watercraft to navigate the harbor area. Both Escanaba and Menominee, the nearest harbors of refuge, are 25 miles away. The proposed work would consist of two pier structures, dredging, beach nourishment, and removal and subsequent disposition of the old east pier material. The proposed east pier would be constructed to a length of 875 feet and the 230 foot long west pier would be rehabilitated. A 10 foot project depth entrance channel and an 8 foot inner harbor channel would be dredged to facilitate access to the proposed small boat harbor which would also serve as a harbor of refuge. Dredged material from the entrance and inner channels would be deposited as beach nourishment material on the shoreline and littoral zone adjacent to the lake side of the east pier. Material from the old east pier would be removed and utilized as underwater fishery habitats.

2. PROJECT DESCRIPTION

a. Description of the proposed discharge of dredged or fill materials.

(1) General characteristics of materials

(a) Construction materials for the proposed piers - Materials would consist of breakwater coverstone, corestone fill and concrete aggregates.

(b) Entrance channel - Primarily beach sand with 1-3% detrital material (charred wood and sawdust).

(c) Inner channel - Primarily beach sand with 3-5% detrital material (bark, sawdust, and fragmented shells) and a small quantity of gravel.

(d) Old east pier remnants - Deteriorated timber piles and timber sheeting enclosing stone fill.

(2) Quantity of material to be discharged. The east and west piers would require about 24,000 tons of stone. Approximately 38,000 cubic yards of dredged material would be initially discharged onto the lake side shoreline zone of the proposed east pier. About 1500 cubic yards of material from the old east pier would be removed and subsequently disposed for use as underwater fishery habitat.

(3) Source of material. Fill would come from the dredged navigation channel, local quarries, and from the old east pier.

b. Description of the proposed disposal site for dredged or fill materials.

(1) Location. The proposed east pier would be located on lake bottomland perpendicular and attached to the shoreline at the mouth of the Cedar River. The west pier would be repaired as it stands.

The site for the deposition of the uncon[illegible]d dredged material would be on the lake s[illegible]oreline zone of the pro[illegible]ier. The material from the old east pi[illegible]be used as fishery h[illegible]be placed on lake bottomland [illegible]one half mile south of [illegible]ds, between the 15-20 foot contours. The material would be p[illegible] two or three piles about six feet high. This would allow for a 15-[illegible] foot clearance for watercraft.

(3) Method of discharge. It is anticipated that material for the piers would be transported to the site by truck and constructed with land based equipment . Beach nourishment would utilize dredging equipment for discharge. Marine equipment, (i.e. barge), would be used to [illegible] material from the old east pier to the proposed fishery habitat [illegible] discharged from the barge.

(4) Time of disposal. Construction would take place in 19[illegible]-8[illegible]. Dredging would take place between mid-June and the first of October of both years.

(5) Projected life of the discharge site(s). The project life is 50 years. Periodic dredging and disposal would be required.

3. PHYSICAL EFFECTS

a. Potential destruction of wetlands - effects on wetlands: There are two separate wetlands near the project area. They would not be significantly affected by the disposal of fill material.

(1) Foodchain Production - Construction of the east pier, rehabilitation of the west pier, removal of the old east pier, and deposition of dredge material onto adjacent shorelines would take place in close proximity to wetland areas. However, these activities would have little or no effect on foodchain production in the wetlands.

(2) Nesting, Spawning, Rearing, and Resting Sites for Aquatic or Land Species - Proposed plan activities would not affect existing wetland sites.

(3) General Habitat - Proposed plan activities would not significantly interfere with the general aquatic and terrestial environment of the wetland areas.

(4) Those Areas set aside for Aquatic Environment Study, Sanctuaries or Refuges - There are approximately 24 acres of wetland near the project site. These wetlands are located inside J.W. Wells State Park and are under the management of the State of Michigan. The proposed project would cause little or no impact on the park or the wetlands.

(5) Natural Drainage Characteristics - Natural drainage of the wetlands would not be affected by the proposed project.

(6) Sedimentation Patterns - Deposition of dredged materials onto the shoreline should not affect local sedimentation patterns, so would have no effect on the wetlands. The east and west piers would cause some accretion of littoral material on their outward sides, but this would not be expected to affect the wetlands.

(7) Salinity Distribution - Not applicable.

(8) Flushing Characteristics - There should be no change in the flushing characteristics of long-shore currents on the harbor.

(9) Current Patterns and Wave Action, or Storm Damage Protection - Nourishment would maintain a stable beach and shoreline area and prevent erosion. The wetlands are not dependent on periodic wave-wash flooding and would not be adversely affected.

(10) Storage Areas for Storm Water and Floodwater.- Because of the close proximity to the river mouth and Lake Michigan, the wetlands do not serve a function of storage for storm water and floodwaters.

(11) Prime Natural Recharge Areas - The proposed project activities would have no significant impact on the natural recharge of ground water in the project area.

b. Impact on water column

(1) Reduction in light transmission - Suspension of sediments in the water column and reduction of light penetration would temporarily adversely affect nekton or plankton in the area. However, **when proposed project activities cease, the water would return to its normal clear state. Suspended material would be primarily sand and would quickly resettle.**

(2) **Aesthetic values** - Turbidity could be aesthetically displeasing to some recreationalists and shore residents. However, turbidity would be generated only during **proposed project activities.**

(3) Direct destruction effects on nektonic and planktonic populations - Impact on these populations would be minor due to the nature of the fill material. Some phytoplankton and zooplankton would be destroyed. Some nektonic species would be temporarily displaced.

c. Covering of benthic communities

(1) Actual covering of benthic communities - At the pier construction site - All benthic communities on the proposed site would be destroyed beneath the rubblemound material. At the beach nourishment site - Benthos at this site would be buried. After the disposal is accomplished, repopulation of the affected area would occur. Complete recovery would probably occur in 1 or 2 years. At the fishery habitats site-Any benthos at this site would also be buried.

(2) Changes in community structure of function - No significant adverse effect in community structure or function would result. Aquatic organisms displaced or destroyed would be replaced after construction ceases. The pier and fishery habitats would create new aquatic habitat, a benefit to species numbers and diversity, and to predator species.

d. Other effects

(1) Changes in bottom geometry and substrate composition - Construction of the rubblemound pier, beach nourishment and building of the fishery habitats would all change bottom geometry and substrate composition on the relatively flat bottomland. Approximately 12 acres of lake bottomland would be changed.

(2) Water circulation - There would be no impact on water circulation patterns.

(3) Exchange of constituents between sediments and overlying water with alternations of biological communities - Material would consist of uncontaminated sand, gravel and stone, which should not release constituents to the overlying water column that would cause alterations of biological communities.

4. CHEMICAL - BIOLOGICAL INTERACTIVE EFFECTS

The fill materials are uncontaminated sand, gravel and stone. Therefore, no adverse chemical effects would be anticipated.

5. DESCRIPTION OF SITE COMPARISON

a. Total sediment analysis - Sediments in the project area are uncontaminated. No comparison of site sediments is necessary.

b. Biological community structure analysis - No biological community structure analysis was performed. The proposed pier and fishery habitats would create habitat for different species. The enrichment would be beneficial to the aquatic community. Deposition of material at the beach nourishment site is not expected to alter the community structure, since the disposal site is directly adjacent to the dredging site and the materials are similar to those at the dredging site.

6. REVIEW APPLICABLE WATER QUALITY STANDARDS

a. Fill material would consist of uncontaminated quarried rock and clean sand and gravel. None of the materials would affect water quality due to their non-liquid nature. Fill activities would be in compliance with applicable water quality standards.

b. Mixing zone - Since materials to be placed at the construction site, beach nourishment site, and fishery habitats site are uncontaminated, there would be only minor effects on water quality. State of Michigan standards would not be violated.

c. Based on a. and b. above, will disposal operations be in conformance with applicable standards? - Disposal operation and fill activities would be in conformance with applicable water quality standards.

7. SELECTION OF DISPOSAL SITES FOR FILL MATERIAL

a. Need for proposed activity - The primary project justification is the need for the construction of a recreational boat harbor and harbor of refuge consisting of a pier structure, and the subsequent need for a site at which to place the uncontaminated dredged material from the harbor channel.

b. Alternatives considered. Three (3) alternatives including a no action alternative were considered. These were rejected for environmental, technical and economic reasons. Each alternative is fully discussed in the Environmental Impact Statement. Upland disposal for the dredged material is not practicable since it is not contaminated.

c. Objectives to be [illegible] in discharge determinations.

(1) Impacts on the chemical, physical, and biological integrity of aquatic ecosystem - Impacts on these parameters would not be significant because clean fill material would recover from dredged material deposition.

(2) Impacts on foodchains - The proposed plan would impose minimal impacts on the food chains. The proposed pier and fishery habitats would enhance species diversity with the possible expansion of foodchains.

(3) Impacts on diversity of plant and animal species - Ultimately, the habitat at the beach nourishment disposal site would not change, therefore, plant and animal species diversity would not be expected to change. The pier and the fishery habitats would create new habitat, thus enhancing species diversity.

(4) Impact on movement into and out of feeding, spawning, breeding and nursery areas - No significant impact would be expected on the movement into and out of these areas.

(5) Impact on wetland areas having significant functions of water quality maintenance - No wetland areas would be affected.

(6) Impact on areas that serve to retain natural high waters or flood waters - No natural areas that serve in the retention of high waters or floodwaters are in the project area.

(7) Methods to minimize turbidity - Construction of the pier would cause minimal turbidity because it would be constructed of stone. Extraordinary methods to control turbidity would not be necessary at the beach nourishment disposal site.

(8) Methods to minimize degradation of aesthetic, recreational and economic values - Rubblemound material rather than steel sheet pilings for the pier construction would look more natural and thus enhance the appearance of the structure. The use of stone is also more economical. There are no further appropriate measures to minimize degradation.

(9) Threatened and endangered species - The only mammal classified as endangered that might be found in the area is the Eastern timber wolf (Canis lupus lycaon). The bald eagle (Haliaeetus leucocephalus) is the only threatened bird in the area. A reoccupied nesting site is located about five miles northeast of Cedar River. A list of threatened and endangered species which could live in habitat similar to the Cedar River area, but have not yet been found there, is in the EIS.

d. Impacts on water uses at proposed disposal-sites.

(1) Municipal water supply intakes - There are no municipal water supply intakes in the river or lake.

(2) Shellfish - There are [illegible] shellfish beds at the beach nourishment, pier construction, or the fishery habitats sites.

(3) Fisheries - No change in fish species or populations is anticipated. The proposed pier would not interfere with movement of migrating fish and no known spawning area would be removed from use. More fish would be caught by sport fishermen using the proposed pier but properly managed sport fishing does not normally hurt the overall population. The pier would also provide cover for a variety of aquatic plants and animals and the fish [illegible] prey upon them. A list of migratory fish that utilize the Cedar River [illegible] spawning is listed in the EIS. To avoid possible adverse impacts to fish and associated fishery activities, the proposed dredging would not be scheduled during periods when fish spawn and migrate in the area. The fishery habitats would provide benefits similar to that of the proposed pier.

(4) Wildlife - There would be little or no adverse impact on wildlife.

(5) Recreational activities - Aesthetic appearance and recreational activities in the project area may be temporarily disrupted by the presence of trucks and equipment for pier construction, dredging, beach nourishment activities, and by water turbidity.

(6) Threatened and endangered species - No threatened or endangered species would be directly affected by the proposed project.

(7) Benthic life - Disposing the dredged material at the beach nourishment site would cover existing benthos there. The pier would remove a small amount of lake bottomland. However, no significant permanent loss of benthic habitat is foreseen. New habitat would be created by the rubblemound pier and fishery habitats. The loss and disruption of the benthic communities would temporarily affect foodchain production; however; these effects would not be significant.

(8) Wetlands - There would be no significant effects on use of the wetlands.

(9) Submerged vegetation - No significant beds of submerged vegetation exist in the project area.

(10) Size of disposal sites - Approximately 6 acres of Lake Michigan bottomland would be utilized for disposal of the uncontaminated dredgings for beach nourishment. The pier would use 1.5 acres and the fishery habitats would occupy between 2 or 3 acres.

(11) Coastal Zone Management Programs - Pursuant to the requirements for Federal consistency, the proposed project at Cedar River complies with the criteria of the Michigan Coastal Management Program and in particular those objectives which would fulfill recreational needs and provide harbors of refuge and mooring facilities.

e. Considerations to minimize harmful effects

(1) Water quality criteria - The quality of the water at the project site would temporarily be degraded as a result of discharge of material at the

beach nourishment site the creation of an offshore [illegible] habitat and in the process [illegible] construction and rehabilitation of the piers. However, water quality effects from project related fill activities would not be in conflict with Michigan water quality standards. Further efforts to minimize the effects would not be appropriate.

(2) Investigate alternatives to open water fill - An upland dredged material disposal site would be impractical because the material is uncontaminated.

(3) Investigate physical characteristics of alternative disposal sites - The selected placement site is the most appropriate alternative for the disposal of uncontaminated dredged material. An alternative site would not appropriately minimize harmful physical effects to a further degree.

(4) Coordinate potential monitoring activities at disposal site with EPA - Because the fill material is clean, no monitoring activities are planned.

7. STATEMENT AS TO CONTAMINATION OF FILL MATERIAL IF FROM A LAND SOURCE - Clean fill material from commercial quarries would be used for the project. No leaching of unacceptable quantities, concentrations or forms of constituents deemed critical to the environment would be expected.

8. CONCLUSIONS AND DETERMINATIONS

a. An ecological evaluation has been made following the guidance of 40 CFR 230.4 in conjunction with the evaluations and considerations in 40 CFR 230.5.

b. Appropriate measures have been identified and incorporated into the proposed plan to minimize adverse effects on the aquatic environment as a result of the discharge.

c. Consideration has been given to the need for the proposed activity, the availability of alternate sites and methods of disposal that are less damaging to the environment, and such water quality standards as are appropriate and applicable by law.

d. The materials to be deposited are stone, sand, a small amount of sawdust, detrital material, and some gravel. These materials would not have an adverse impact on the envirnment. The sites selected are the least environmentally damaging alternatives reasonably available.

e. The fill material would be deposited on lake bottomland as a pier and fishery habitat. Fill would also be used as beach nourishment. They would not cause permanent unacceptable disruption to the beneficial water quality uses of the ecosystem.

10. FINDING - The sites for construction and rehabilitation of piers, creation of fishery habitats, and beach nourishment disposal at Cedar River, Michigan have been specified through the application of the Section 404 (b)(1) Guidelines.

SECTION 8

CORRESPONDENCE WITH STATE AND FEDERAL AGENCIES

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST
CHICAGO, ILLINOIS 60604

Mr. P. McCallister
Chief, Engineering Division
U.S. Army Engineer District, Detroit
Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

We have completed our review of the Cedar River Harbor Sampling Program. According to the information provided therein, the sediments to be dredged in the harbor improvement are unpolluted sand suitable for beach nourishment.

Thank you for providing us the opportunity to review the subject document.

Sincerely yours,

for Barbara J. Taylor, Chief
Environmental Impact Review Staff
Office of Federal Activities

FISH AND WILDLIFE SERVICE
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

IN REPLY REFER TO:
AFA-SE

MAY 14 1979

Colonel Melvyn D. Remus
District Engineer
U. S. Army Engineer District
Detroit
Attn: P. M. McCallister
Chief, Engineering Div.
P. O. Box 1027
Detroit, Michigan 48231

Dear Colonel Remus:

This is in response to your letter of May 1, 1979, (NCEED-ER), in which you requested endangered species information for the Cedar River Harbor project in Menominee County, Michigan.

Based upon information currently available, the following threatened (T), endangered (E), or proposed (P) species may be found within the project area:

American Peregrine Falcon (E)	(Falco peregrinus anatum)
Arctic Peregrine Falcon (E)	(Falco peregrinus tundrius)
Bald Eagle (T)	(Haliaeetus leucocephalus)
Heart-leaf, Plantain (P)	(Plantago cordata)

There is no designated Critical Habitat in the project area.

In accordance with the Endangered Species Act of 1973, as amended, the Federal Agency responsible for actions authorized, funded, or carried out in furtherance of the project is required to conduct a biological assessment for the purpose of identifying endangered or threatened species likely to be affected by the action. If the biological assessment indicates the presence of such species, the formal consultation process should be initiated. This should be done by writing to the Regional Director, U. S. Fish and Wildlife Service, Federal Building, Fort Snelling, Twin Cities, Minnesota 55111.

After receiving the species information the biological assessment is to be completed within 180 days, and before contracts are entered into or construction begun.

The biological assessment should include the following information:

1. Identification of the species and any legally determined Critical Habitats or any habitat considered to be essential to the species present in the area influenced by the construction.

2. A description of the kinds and time period of the construction.

3. An assessment of the potential impacts of the project on the species or Critical Habitat.

4. A discussion of efforts taken to eliminate any adverse effects or impact on the species or habitats.

If there are any questions regarding the biological assessment or how it applies to the consultation process, please contact the Region 3 Endangered Species Office at 725-3596.

Sincerely yours,

Charles A. Hughlett

Charles A. Hughlett
Acting Regional Director

United States Department of the Interior
FISH AND WILDLIFE SERVICE
EAST LANSING FIELD OFFICE (ES)
Room 301, Manly Miles Building
1405 S. Harrison Road
East Lansing, Michigan 48823

IN REPLY REFER TO:

September 10, 1979

Colonel Robert V. Vermillion
U.S. Army Engineer
Detroit District
P.O. Box 1027
Detroit, Michigan 48231

Dear Colonel Vermillion:

On September 5, 1979, we received a call from Mr. Dick Price, of your staff, soliciting our comments on a proposed reduction in length of the proposed pier for the Cedar River Harbor of Refuge Project, Menominee County, Michigan.

The following comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and in compliance with the intent of the National Environmental Policy Act of 1969.

We have no objection to a reduced pier length. We recommend, however, that the old existing pier materials that will extend beyond the proposed pier be left in place as fishery habitat. During our fisheries survey conducted last spring (June 19-21, 1979), yellow perch, burbot, northern pike, shiners, smallmouth bass, and white suckers were collected adjacent to the old rubble mound pier. Large numbers of brown trout reportedly frequent the area in early spring and in the fall. We would suggest that a series of permanent markers be installed along the remaining pier materials since it could result in a navigation hazard during periods of high water.

We appreciate this early notification of the proposed refinement in the project plans. Please notify our office of your proposed action regarding our recommendation. We would also appreciate receiving a copy of the updated plans at your earliest convenience.

Sincerely yours,

Clyde R. Odin
Supervisor

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

[illegible]
[illegible] District
[illegible]
Cleveland, Ohio 44199
Phone: [illegible]

[illegible]
[illegible]
28 December 1979

From: Commander, Ninth Coast Guard District
To: District Engineer, U. S. Army Corps of Engineers, Detroit District

Subj: Cedar River Harbor, Michigan

Ref: (a) NCEED-T dtd 28 SEP 79

1. It is planned to utilize a standard Coast Guard 20' pole structure with battery operated light to mark the new 375' east pier. Drawings for this structure are on file with your office.

2. Presently we plan to continue using the existing structure on the west pier. The structure is in need of sandblasting and painting and possibly some minor repair.

3. The Coast Guard cannot endorse the recommendation that the remains of the old pier extending beyond the new east pier be left in place. Leaving this submerged hazard in place is, in our opinion, contrary to the purpose of this project which is to provide a safe harbor. The primary users of Cedar River Harbor are recreational boaters who frequently are inexperienced and are not acquainted with the proper use of charts and other marine publications such as the Light List and Coast Pilot. In the interest of safety, we believe it imperative that the lengthy submerged pier be removed down to the natural bottom.

C. A. MILLRADT
By direction

United States Department of the Interior

FISH AND WILDLIFE SERVICE
P. O. Box 758
Marquette, Michigan 49855
March 9, 1979

IN REPLY REFER TO:

Edmands Engineering, Inc.

MAR 16 1979

Route To:

Mr. Brian Kroll
Edmands Engineering
1501 West Thomas
Bay City, Michigan 48706

Dear Mr. Kroll:

Attached is a list of fishes collected or observed during sea lamprey control operation on the Cedar River. Because the equipment and techniques used in our program are not effective on all species, I strongly suggest that you contact the Michigan Department of Natural Resources for any additions to this list.

Sincerely,

Paul C. Rugen

Paul C. Rugen,
Supv. Fishery Biologist (Gen.)

PCR/es

Enc.

Cedar River - Fish Species

Lampreys
- Sea lamprey (Petromyzon marinus)
- Silver Lamprey (Ichthyomyzon unicuspis)
- Northern brook lamprey (Ichthyomyzon fossor)
- American brook lamprey (Lampetra lamottei)

Trouts
- Brown trout (Salmo trutta)
- Brook trout (Salvelinus fontinalis)
- Rainbow trout (Salmo gairdneri)
- Coho salmon (Oncorhynchus kisutch)

Suckers
- White sucker (Catostomus commersoni)
- Northern hog sucker (Hypentelium nigricans)
- Longnose sucker (Catostomus catostomus)
- Redhorse sp. (Moxostoma sp.)

Catfishes
- Yellow bullhead (Ictalurus natalis)
- Black bullhead (Ictalurus melas)
- Brown bullhead (Icatalurus nebulosus)
- Tadpole madtom (Noturus gyrinus)

Minnows
- Carp (Cyprinus carpio)
- Golden shiner (Notemigonus crysoleucas)
- Creek chub (Semotilus atromaculatus)
- Lake chub (Couesius plumbeus)
- Hornyhead chub (Nocomis bigattata)
- Pearl dace (Semotilus margarita)
- Finescale dace (Phoxinus neogaeus)
- Northern red belly dace (Phoxinus eos)
- Blacknose dace (Rhinichthys atratulus)
- Longnose dace (Rhinichthys cataractae)
- Common shiner (Notropis cornutus)
- Spottail shiner (Notropis hudsonius)
- Brassy minnow (Hybognathus hankinsoni)
- Emerald shiner (Notropis atherinoides)
- Bluntnose minnow (Pimephales notatus)
- Rosyface shiner (Notropis rubellus)
- Blacknose shiner (Notropis heterolepis)

Perches
- Walleye (Stizostedion vitreum vitreum)
- Yellow perch (Perca flavescens)
- Blackside darter (Percina maculata)
- Logperch (Percina caprodes)
- Johnny darter (Etheostoma nigrum)
- Fantail darter (Etheostoma flabellare)
- Iowa darter (Etheostoma exile)
- Greenside darter (Etheostoma blennioides)

Sunfishes

Smallmouth bass (Micropterus dolomieui)
Largemouth bass (Micropterus salmoides)
Rock bass (Ambloplites rupestris)
Bluegill (Lepomis macrochirus)
Pumpkinseed (Lepomis gibbosus)
Longear sunfish (Lepomis megalotis)
Green sunfish (Lepomis cyanellus)

Others

Northern pike (Esox lucius)

Burbot (Lota lota)

Bowfin (Amia calva)

Rainbow smelt (Osmerus mordax)

Central mudminnow (Umbra limi)

Trout-perch (Percopsis omiscomaycus)

Alewife (Alosa pseudoharengus)

Mottled sculpin (Cottus bairdi)

Brook stickleback (Culea inconstans)

American eel (Anguilla rostrata)

MICHIGAN DEPARTMENT OF STATE
RICHARD H. AUSTIN SECRETARY OF STATE

LANSING
MICHIGAN 48918

MICHIGAN HISTORY DIVISION
ADMINISTRATION, ARCHIVES, HISTORIC SITES, AND PUBLICATIONS
3423 N. Logan Street
517-373-0510
STATE MUSEUM
505 N. Washington Avenue
517-373-0515

March 21, 1979

Mr. Philip McCallister
Chief, Engineering Division
Detroit District, Corps of Engineers
Box 1027
Detroit, Michigan 48231

RE: ER-2587 (MHD)
Cedar River Harbor

Dear Mr. McCallister:

Our staff has reviewed the proposed plans for channel improvement in Cedar River Harbor and has determined that there will be no effect on significant cultural resources.

Any questions should be directed to Dr. John R. Halsey, Environmental Review Coordinator for the Michigan History Division. Thank you for soliciting our comments on this project.

Sincerely,

Martha M. Bigelow
Director, Michigan History Division
and
State Historic Preservation Officer

BY: Michael J. Washo
Deputy State Historic Preservation Officer

MJW/JRH/cw

MH-69

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

STEVENS T MASON BUILDING
BOX 30028
LANSING MI 48909

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

May 30, 1979

NCEED-T

Colonel Melvyn D. Remus
District Engineer
U. S. Corps of Engineers
P. O. Box 1027
Detroit, Michigan 48231

Re: Cedar River Harbor-of-Refuge

Dear Colonel Remus:

Director Tanner has asked that I reply to your 8 May 1979 letter concerning the proposed improvements to the above harbor. The Department's Corps Project Review Committee has discussed the project and concurs with the redesign.

I am advised that reconfirmation of local cooperation for the Cedar River Harbor-of-Refuge project will be discussed at the May-June Waterways Commission meeting. You may expect to hear directly from Keith Wilson as to the Commission's action on the assurances.

Thank you for providing the opportunity to review and comment upon this project.

Sincerely,

L. N. Witte

L. N. Witte, P.E., Chief
Water Management Division

LNW:cjs

cc: K. Wilson
R. Compeau

CHIGAN
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1 1/79

WILLIAM G [illegible] Governor

DEPARTMENT OF NATURAL RESOURCES
HOWARD A. TANNER, Director

STEVENS T MASON BUILDING
BOX 30028
LANSING MI 48909

May 1, 1980

Mr. Philip A. McCallister, Chief
Engineering Division
U. S. Corps of Engineers
P. O. Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

Thank you for your April 16, 1980 correspondence concerning improvements to the Cedar River Recreational Boat Harbor, Menominee County, Michigan. The department is very interested in your proposal to build fisheries habitat from remnants of the old east pier. Fisheries Division and the Corps Project Review Committee are currently investigating the proposal and reviewing locations for a submerged reef. Their findings will be communicated to you in the near future.

Questions regarding this proposal should be directed to Mr. L. N. Witte, Chief, Water Management Division, telephone (517) 373-3930.

Sincerely,

Howard A. Tanner

Howard A. Tanner
Director

MICHIGAN
THE GREAT LAKE STATE

R1026 1/79

STATE OF MICHIGAN

WILLIAM G. M[illiken], Governor

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

July 28, 1980

Mr. Philip A. McCallister, Chief
Engineering Division
U. S. Corps of Engineers
P. O. Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

The Fisheries Division of the Department of Natural Resources has reviewed the proposal for creation of fish reefs at Cedar River Harbor, using materials from the old east pier, and offers the following suggestion for their location.

The lake bottom near the mouth of the Big Cedar River is relatively flat, and the creation of fish reefs along either side of the river mouth would serve to increase fishing opportunities in this area. In order to allow 10-12 foot clearance for recreational boats, the reefs would have to be placed between the 15 and 20 foot contour, with old pier materials deposited in two or three piles approximately six feet high with small but stable bases. Fisheries personnel has offered to buoy these sites at the appropriate time.

Thank you for the opportunity to provide input on this matter. Please call me if and when you would like to have the sites bouyed, or if you have any questions.

Sincerely,

L. N. Witte

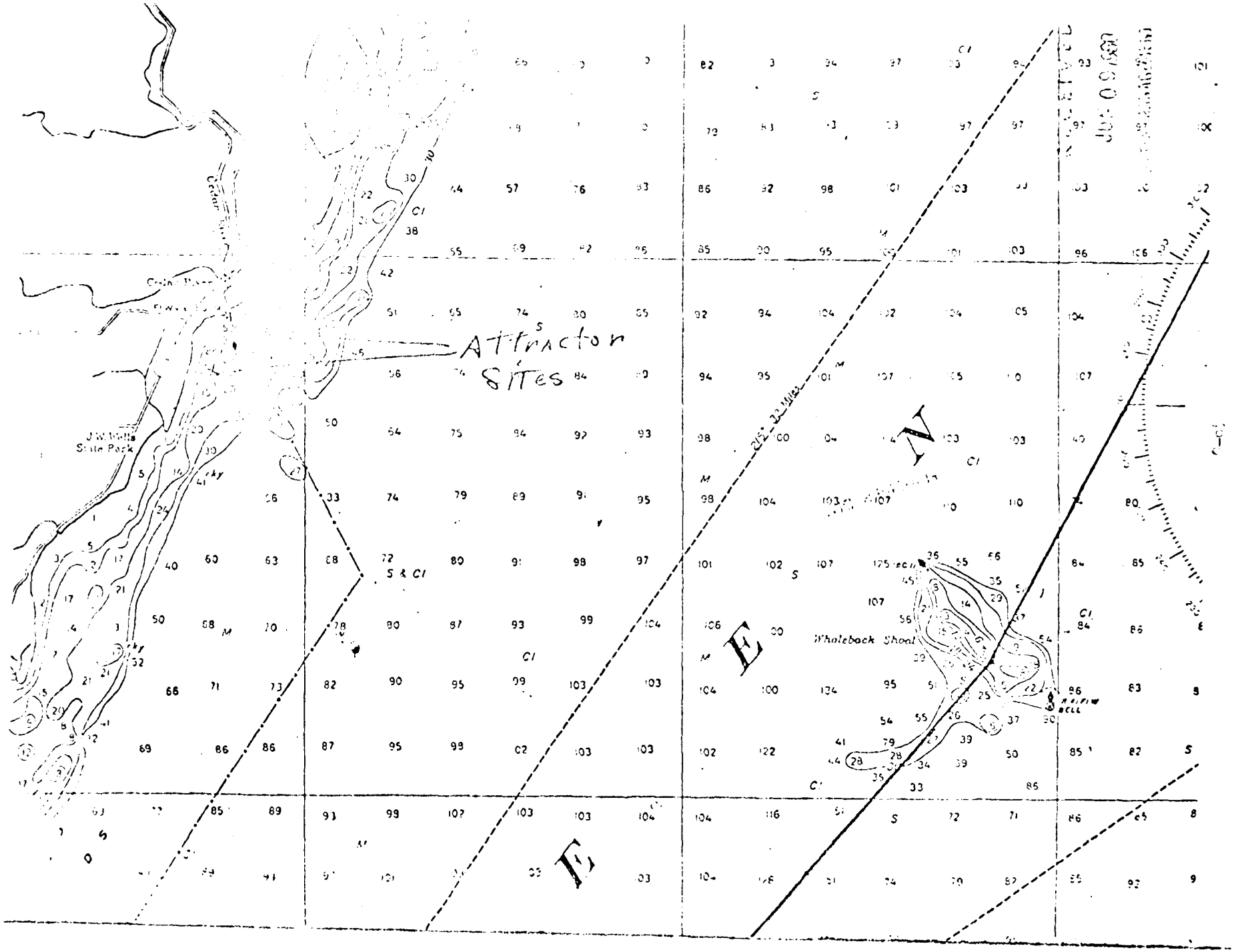
L. N. Witte, P.E., Chief
Water Management Division

LNW/ELW:cjs

cc: N. Fogle, Fisheries Division
B. L. Jacob, Dist. 2

MICHIGAN
THE GREAT LAKE STATE

RI-026 1/79


Attractor Sites
J.W. Mills State Park
Whaleback Shoal
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TELEPHONE OR VERBAL CONVERSATION

For use of this form, see AR 340-15; the proponent agency is The Adjutant General.

DATE: 10 Apr 86

SUBJECT OF CONVERSATION: Cedar River Harbor Project - Disposal of pier materials for use as fish habitat in regards to depth & navigation hazard

INCOMING CALL

PERSON CALLING	ADDRESS	PHONE NUMBER AND EXTENSION

PERSON CALLED	OFFICE	PHONE NUMBER AND EXTENSION

OUTGOING CALL

PERSON CALLING	OFFICE	PHONE NUMBER AND EXTENSION
R. Zomparelli	U.S. Army Corps of Eng. (ERB) Detroit Dist.	66236

PERSON CALLED	ADDRESS	PHONE NUMBER AND EXTENSION
B. Grasior	Ninth Coast Guard Dist. Cleveland, Ohio	8-216-2372

SUMMARY OF CONVERSATION

R. Zomparelli talked with B. Grasior about disposal of old pier materials for proposed fish habitat. R. Zomparelli inquired about the navigational hazard to recreational & commercial watercraft that the proposed fish habitat would pose if not placed in deep enough water. B Grasior suggested that a site be chosen which would provide at least 10-12' clearance from the top of proposed fish habitat to the L.W.D. line. R. Zomparelli agreed because watercraft which would navigate the area generally would not have a draft of more than 7 feet and the 10-12' would provide safe adequate clearance. R. Zomparelli stated that he would pass this info to MDNR.

Ray Zomparelli

DA FORM 751 APR 66 REPLACES EDITION OF 1 FE [illegible] WILL BE USED.

[illegible] 16-83831 1 GPO

SECTION 9

CORRESPONDENCE RECEIVED ON
DRAFT ENVIRONMENTAL IMPACT STATEMENT

United States Department of the Interior

OFFICE OF THE SECRETARY
NORTH CENTRAL REGION
175 WEST JACKSON BOULEVARD
CHICAGO, ILLINOIS 60604

ER 80/439

June 23, 1980

Colonel Robert Vermillion
District Engineer
U.S. Army Engineer District
Detroit
P.O. Box 1027
Detroit, Michigan 48231

Dear Colonel Vermillion:

We have reviewed the revisions to General Design Memorandum No. 1 and the Draft Environmental Statement for the Recreational Boat Harbor at Cedar River, Menominee County, Michigan (ER 80/439).

The following comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et. seq.) and in compliance with the intent of the National Environmental Policy Act of 1969.

Boating activity can be expected to increase (in the Cedar River area) as a result of improved harbor and channel conditions, so the necessity for emergency services could also be expected to increase. The statement should discuss boaters' safety relative to increased activity, the extent to which current emergency services are available, and whether projected needs can be met. Information such as emergency service locations, types of services provided, and estimates of "on-site arrival times" should be given.

The Heritage Conservation and Recreation Service has provided Land and Water Conservation Fund (LWCF) assistance for J. W. Wells State Park. The assisted area is located immediately to the west of the proposed project but would appear not to be adversely affected. However, should land from the site be converted to other than public outdoor recreation uses, a Section 6(f) conflict would result. Section 6(f) of the Land and Water Conservation Fund Act states:

"No property acquired or developed with assistance under this section shall, without the approval of the Secretary, be converted to other than public outdoor recreation uses. The Secretary shall approve such conversion only if he finds it to be in accord with the then existing comprehensive statewide outdoor recreation plan and only upon such conditions as he deems necessary to assure the substitution of other recreation properties of at least equal fair market value and of reasonably equivalent usefulness and location."

With regard to possible 6(f) conflicts, the State Liaison Officer responsible for administration of the LWCF program in the State of Michigan is Mr. O. J. Scherschligt, Deputy Director, Department of Natural Resources, Box 30028, Lansing, Michigan 48909.

No significant adverse effects on fish and wildlife resources or their habitats are expected to result from the presently proposed work.

Sincerely yours,

Franklin Stevens

Regional Environmental Officer

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

REPLY TO ATTENTION O

Colonel Robert V. Vermillion
District Engineer
U.S. Army Engineer District, Detroit
P.O. Box 1027
Detroit, Michigan 48231

24 JUN 1980

RE: 80-022-133
D-COE-F32066-MI

Dear Colonel Vermillion:

We have completed our review of the Draft Environmental Impact Statement (EIS) and General Design Memorandum on the proposed Recreational Boat Harbor at Cedar River, Michigan. It is our understanding that the authorized project consists of pier construction, entrance and inner channel dredging, turning basin dredging, removal of an old pier, and shoreline enhancement using clean dredged material. Alternatives to the project consist of the no-action alternative and alternative designs for the pier.

Based on the information provided in the documents mentioned above, we believe the proposed action and its alternatives will have only minor adverse effects on the environment. The proposed action (Alternative 2 - 875 ft. straight pier) appears to maximize navigational benefits without significantly impacting the surrounding environment; thus, we have no objections to the proposed action.

Since we have no specific comments to offer on the proposed activities, we are classifying the Draft EIS as LO-1. This means we lack objections to the environmental impacts associated with the project, and the environmental statement adequately identifies these impacts. In accordance with U.S. Environmental Protection Agency procedures, our classification of this project will be published in the Federal Register.

Thank you for the opportunity to review and comment on the Draft EIS. Upon issuance of the Final EIS, please forward 3 copies for our review. If there are any questions concerning our review of this project, please contact Mr. James Hooper of my staff at 312/886-6694.

Sincerely yours,

Barbara J. Taylor

Barbara J. Taylor, Chief
Environmental Impact Review Staff
Office of Environmental Review

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
NORTHEASTERN AREA STATE AND PRIVATE FORESTRY
370 REED ROAD — BROOMALL, PA. 19008
Telephone: (215) 461-3170

1950
June 25, 1980

P. McCallister, Chief
Engineering Division
Detroit District, Corps of Engineers
Dept. of the Army
Box 1027
Detroit, MI 48231

Refer to: NCEED-ER
Draft Environmental Impact
Statement, Recreational Boat
Harbor, Cedar River, MI

Dear Mr. McCallister:

We agree that this project would cause little if any adverse impact on upland or wetland vegetation.

Thank you for the opportunity to review this statement.

Sincerely,

for JOHN F. CHANSLER
Assistant Area Director
Resource Protection

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Productivity, Technology, and Innovation
Washington, D.C. 20230
(202) 377-4335

June 20, 1980

U. S. Army Engineer District, Detroit
ATTN: Chief, Environmental Resources Branch
Post Office Box 1027
Detroit, Michigan 48231

Gentlemen:

This is in reference to your draft environmental impact statement entitled, "Recreational Boat Harbor, Cedar River, Michigan." The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving eight copies of the final environmental impact statement.

Sincerely,

John B. Cox, for

Bruce R. Barrett
Acting Director
Office of Environmental Affairs

Enclosures Memos from: Mr. Robert B. Rollins
National Ocean Survey - NOAA

Mr. Eugene J. Aubert
Environmental Research Laboratories - NOAA

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL GEODETIC SURVEY
Rockville, Md. 20852

JUN 6 1980

OA/C52x6:JLR

Rec'd 6/9/80 PP/EC

TO: PP/EC - Joyce M. Wood

FROM: OA/C5 - Robert B. Rollins

SUBJECT: DEIS #8005.03 - Recreational Boat Harbor; Cedar River, Michigan (Supplement No. 1)

The subject statement has been reviewed within the areas of the National Ocean Survey's (NOS) responsibility and expertise, and in terms of the impact of the proposed action on NOS activities and projects.

The National Ocean Survey found Appendix B - Hydraulic Analysis to be extremely thorough, accurate, and more than adequate for the proposed project.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL RESEARCH LABORATORIES
Great Lakes Environmental Research Laboratory
2300 Washtenaw Avenue
Ann Arbor, MI 48104

June 3, 1980

TO: PP/EC - Joyce M. Wood

FROM: RD/RF24 - Eugene J. Aubert

SUBJECT: DEIS 8005.J3 Recreational Boat Harbor; Cedar River, Michigan (Supplement No. 1)

The subject DEIS prepared by the Corps of Engineers, Detroit District, on restoration of recreational boat harbor at Cedar River, Lake Michigan has been reviewed and comments herewith submitted.

Restoration of Cedar River Harbor piers and deepening of channel for small craft navigation will increase boat traffic and will have a negative impact on water quality. It is estimated that most of the impact will be limited to the harbor area and the long-term effect on Green Bay environment will remain minor. Wider and deeper entrance channel will allow larger waves to move into the harbor area.

Impact Statement indicates that the section of shoreline north and south of the Cedar River appears to be in an equilibrium state as indicated in aerial photographs (page B-8). Therefore, the net volume of littoral drift south of the river calculated as 138,931 cubic yards in 1975 is not realistic. Data on water level changes in Green Bay and Lake Michigan given on pages B-1 and G-10 require verification and coordination.

rec'd 6/6/80 PP/EC

DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
ATLANTA, GEORGIA 30333

June 4, 1980

U.S. Army Engineer District, Detroit
Attn: Chief, Environmental Resources Branch
P.O. Box 1027
Detroit, Michigan 48231

Dear Sir:

We have reviewed the Revisions to General Design Memorandum No. 1 and Draft Environmental Impact Statement (EIS) for the Recreational Boat Harbor, Cedar River, Michigan. We are responding on behalf of the Public Health Service.

We anticipate no adverse health impact resulting from the improvements described. However, we suggest the final EIS briefly address the following issues mentioned in the General Design Memorandum.

Reference is made on page 18 to provision and maintenance of necessary mooring facilities and utilities, including public landings or wharfs, with provision for potable water and for the sale of motor fuel, lubricants, and a parking lot with adequate sanitary facilities. The final EIS should expound upon these anticipated facilities, identifying type of water treatment, restroom and waste disposal facilities, safety around the fueling stations, and potential impacts regarding these facilities.

We appreciate the opportunity of reviewing this document. Please send us a copy of the final statement when it becomes available.

Sincerely yours,

Frank S. Lisella, Ph.D.
Chief, Environmental Affairs Group
Environmental Health Services Division
Bureau of State Services

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 5
18209 DIXIE HIGHWAY
HOMEWOOD, ILLINOIS 60430

June 17, 1980

IN REPLY REFER TO: HED-05

U.S. Army Engineer District, Detroit
P. O. Box 1027
Detroit, Michigan 48231

ATTN: Chief, Environmental Resources Branch

Gentlemen:

Supplement No. 1 to the General Design Memorandum and Draft Environmental Impact Statement for the Recreational Boat Harbor at Cedar River, Michigan has been reviewed and we have no comments to offer on the statement. The proposed action will not adversely affect the existing Federal-aid routes in the area.

Sincerely yours,

Donald E. Trull
Regional Administrator

By: W. G. Emrich, Director
Office of Environment and Design

FEDERAL ENERGY R[illegible]TORY COMMISSION
CHICAGO [illegible]L OFFICE
230 SOUTH DE[illegible]STREET, ROOM 3130
CHICAGO, ILLINOIS 60604

In reply refer to:
OEPR-CH-RB

May 20, 1980

Mr. Abram Nicholson
Chief, Environmental Resources Branch
U.S. Army Engineer District, Detroit
P.O. Box 1027
Detroit, MI 48231

Your Reference: NCEED-ER

Dear Mr. Nicholson:

This is in response to Mr. Phil McCallister's April 29, 1980 letter inviting our review and comments on the Draft Environmental Impact Statement and the revisions to the General Design Memorandum for the Recreational Boat Harbor at Cedar River, Michigan.

Comments of this office are made in accordance with the National Environmental Policy Act of 1969 and the August 1, 1973 Guidelines of the Council on Environmental Quality. Our review of the Draft Environmental Impact Statement is to determine the effect on matters concerning the Federal Energy Regulatory Commission's responsibilities. Such responsibilities stem from the Federal Power Act and the Natural Gas Act and relate to the licensing of non-Federal hydroelectric projects and associated transmission lines; participation in planning and development of Federal hydroelectric projects; certification for construction and operation of natural gas pipeline facilities, defined to include both interstate pipeline and terminal facilities; and the permission and approval required for the abandonment of natural gas pipeline facilities.

Because the above-noted proposed development would not pose a major obstacle to the construction or operation of such facilities and because the Draft does not indicate that existing natural gas or hydroelectric developments would be adversely affected, we have no specific comments.

These comments are of this office and therefore do not necessarily represent the views of the Federal Energy Regulatory Commission.

Thank you for the opportunity to comment on this Draft Environmental Statement.

Sincerely,

Lawrence F. Coffill

Lawrence F. Coffill
Regional Engineer

STATE OF MICHIGAN

NATURAL RESOURCES COMMISSION
JACOB A. HOEFER
CARL T. JOHNSON
E.M. LAITALA
HILARY F. SNELL
HARRY H. WHITELEY
JOAN L. WOLFE
CHARLES G. YOUNGLOVE

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES
HOWARD A. TANNER, Director

STEVENS T. MASON BUILDING
BOX 30028
LANSING MI 48909

June 27, 1980

Colonel Robert V. Vermillion
U.S. Army Engineer
Detroit District
P.O. Box 1027
Detroit, Michigan 48231

Dear Colonel Vermillion:

The Michigan Department of Natural Resources has reviewed Supplement Number 1: Revisions to General Design Memorandum No. 1 and Draft Environmental Impact Statement for a Recreational Boat Harbor, Cedar River, Michigan. Although we have no objections to this project, we offer the following comments and recommendations.

Property easements at the mouth of the river may be difficult to obtain. These lands were gifts to the state and some deeds contain reverter clauses which prohibit all but park use of these lands. A precise survey of the actual work site may reveal that the project area is not subject to these reverter clauses. A copy of the deed to the site is enclosed for your convenience.

It is likely that the dredged materials will contain organic matter, including old stumps and logs. We cannot permit the disposal of stumps and logs on the beach nourishment area unless the problems of turbidity and visual appeal are adequately addressed.

The project's impact on littoral processes is admittedly uncertain due to the lack of appropriate data. Since the shoreline is now believed to be in an equilibrium condition (page 15), the potential effects of the harbor structure should be addressed. We suggest that future aerial photographs be used to monitor littoral movement so that any problems that arise can receive prompt mitigative measures.

Finally, we recommend that the Cedar River be dredged no further than the turning basin, unless extending the dredged area beyond the turning basin to the State Highway M-35 bridge can be justified. We cannot endorse any

MICHIGAN
THE GREAT LAKE STATE

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dredging activity unless it can be justified and provides a net benefit to the environment and the public trust.

Thank you for this opportunity to comment and participate in the review process.

Sincerely,

Howard A. Tanner
Director

Enclosure

REFERENCES

1. U.S. Army Corps of Engineers, "Water Level Facts on the Great Lakes" May 1977, 10 pages.

2. U.S. Army Corps of Engineers, "Monthly Bulletin of Lake Levels for the Great Lakes" December, 1978.

3. U.S. Department of Commerce, Weather Bulletin; "Climatic Summary of the United States, Upper Michigan".

4. National Oceanic and Atmospheric Administration, Climatological Summary for Fayette - Sack Bay, December, 1971.

5. Sommers, L.M.; Atlas Of Michigan, Michigan State University Press, 1977.

6. Soil Conversation Service, U.S.D.A.; "General Soil Map Menominee County, Michigan 1972".

7. DNR, Personal Communication from Water Management Division, February 7, 1979 (Appendix C).

8. U.S. Army Corps of Engineers, "Design Memorandum No. 1, Cedar River Harbor, Michigan, August 1968".

9. Personal communication with Duane Wenzel, DNR, Crystal Falls, Michigan.

10. Federal Endangered Species List, Federal Register Volume 44, No. 12, Wednesday, January 17, 1979.

11. Personal communication with Local [illegible] Fisherman.

12. Environmental Research Group, Cedar River Harbor Sampling Program, January 25, 1979.

13. Fish Inventory, U.S. Fish and Wildlife Service.

14. Central Upper Peninsula Planning and Development Region, Population Data, collected February 22, 1979.

15. National Register of Historic Places, Federal Register, Volume 44, No. 26, Tuesday, February 6, 1979.

16. Personal communication with Jim Harter, J.W. Wells State Park Director.

17. Fassett, N.C.; A Manual of Aquatic Plants, University of Wisconsin Press, 1975.

18. "Michigan's Endangered and Threatened Species Program", Michigan DNR.

19. Personal communication with A. Wright, Fishery Division, MDNR, Lansing, Michigan.

20. Personal communication with Bud Jacob, MDNR, Crystal Falls, Michigan.

21. "Use Designation Areas for Michigan's Intrastate Water Quality Standards", MDNR, March, 1969.

22. "Manual for Evaluating Public Drinking Water Supplies", U.S.EPA, EPA-430/9 - 75 - 011.

23. Testing Laboratory Experience, Personal Communication with Environmental Research Group, Inc., Ann Arbor, Michigan.

24. Personal experience, Edmands Engineering, Inc., Bay City, Michigan.

25. U.S. Environmental Protection Agency, Proposed Pollutional Classification of Sediments, 1975.

26. Personal communication with OPS personnel at the Coast Guard air station in Traverse City, Michigan.

27. Supplement No. 1 Revisions to General Design Memorandum No. 1 and Draft Environmental Impact Statement. Recreational Boat Harbor, Cedar River, Michigan. Pgs. G-37 - G-54.

GLOSSARY

Alkaline	- A measure of the capacity of a solution to neutralize hydrogen ions, and having a pH of more than 7.
Aquatic Plants	- Plants that grow in water, either floating on surface, growing by the bottom of the body of water or growing under the surface of the water.
Benthic	- Under water at the bottom of stream, lake or harbor.
Benthos	- Bottom dwelling organisms.
BOD	- Biochemical Oxygen Demand. A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water.
Breakwater	- A long narrow (rubble mound) pile of rock or a concrete structure in the water designed to break or moderate the effect of storm driven waves. Usually placed out into the water from shore at an entry channel to provide safer boat or ship navigation during stormy weather.
Climate	- The average weather over time for a particular place.
COD	- Chemical Oxygen Demand. The amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water.
Coliform	- Any of a number of organisms common to the intestinal tract of man and animals, whose presence is an indicator of pollution.
Conductivity (Specific Conductance)	- A measure of a solution's capacity to convey an electric current.

Contaminant	- Something which will degrade or dirty another thing or a natural system (such as oil in a river).
Copper	- Copper (Cu) is a heavy metal which in trace quantities is essential to life, but which in greater amounts is toxic to life.
Cultural	- Produced by man or resulting from man's actions.
Dissolved Solids, Total (TDS)	- The total amount of dissolved material, organic and inorganic, contained in water or wastes.
DO	- Dissolved Oxygen. The oxygen freely available in water. Unpolluted water will contain more DO than polluted water.
Dredge, Hydraulic	- A barge or ship mounted vacuum suction device, sometimes fitted with an "eggbeater" type cutter head, powered be steam or diesel, which operates by breaking up the sediments with the rotating cutter head and may pump the material from the bottom through pipes to a discharge point at some distance from the equipment, in the water, on land or into a confinement facility. Generally used for dredging muck, soft sediments or sand. Operates with about 20% solids and 80% water.
Dredging	- A method for deepening and widening streams, swamps or coastal waters by scraping and removing solids from the bottom to restore the authorized depths in the established projects.
E.I.S.	- Environmental Impact Statement. A document prepared by a Federal agency on the environmental impact of its proposals for legislation and other major actions significantly affecting the quantity of the human environment. Environmental impact statements are used as tools for decision making and are required by the National Environmental Policy Act (NEPA).

Environment	- [illegible] surroundings. Environment may [illegible] specifically to man or animal, natural or cultural, physical, chemical, biological, social, economic or any combination of the above.
Environmental Impact	- A word used to express the extent or severity of an environmental effect.
Erosion	- The wearing away of the land by the action of wind, water, gravity or a combination thereof. Shoreland erosion on the Great Lakes is most often a result of a combination of wind driving waves beating upon the shore and forming littoral currents, and high water levels.
Fauna	- Animals on land or in the water.
Fecal Coliform	- A group of organisms common to the intestinal tracts of man and of animals.
Flora	- Plants on land or in the water.
Fluvial	- Relating to sediment deposition by moving (river) water.
Food Chain	- Movement of food and energy from one form of life to another; for example, algae to zooplankton to fish.
Genus	- A grouping which consists of a number of similar species.
Groundwater	- Water that exists in a saturation zone of the earth's crust.
Impact	- The effect of one thing upon another. "Environmental" impacts may affect any one or combination of elements in the total environment and may be of positive or negative impact and of long or short duration.

Lead	- Lead (Pb) a heavy metal which is toxic to life.
Littoral	- The shallow waters that extend along the edge of a lake or sea.
Littoral Deposits	- Deposits of littoral drift.
Littoral Drift	- The bottom materials moved in the littoral zone under the influence of waves and current. Direction of movement or "transport" of littoral materials depends upon wind and wave direction.
Mercury	- A heavy metal, highly toxic if breathed or ingested. Mercury is residual in the environment, showing biological accumulation in all aquatic organisms, especially fish and shellfish.
mg/Kg	- Milligram per kilogram.
Mooring Facility	- A place where a ship is fastened.
Navigation Aids	- Lights, horns, bells, symbols placed and maintained by the U.S. Coast Guard to aid boat and ship navigation. Navigation aids are often placed on the outermost end of Corps breakwaters and piers.
Nekton	- Swimming aquatic insects and fish.
Nutrient	- Elements or compounds essential as raw materials for organism growth and development; for example, carbon, oxygen, nitrogen and phosphorus.
pH	- A measure of the relative acid or alkaline state of water. pH is measured on a scale of 0 to 14. A pH of 7 is neutral, a pH below 7 is acid, a pH above 7 is alkaline. Rainwater is usually slightly acid.

Phenols	- A group of organic compounds that in very low concentrations produce a taste and odor problem in water.
Phosphorus	- An element, that while essential to life, contributes to the eutrophication of lakes and other bodies of water.
Phytoplankton	- The plant portion of plankton.
Piers	- Permanent structures constructed of stone, steel, cement or a combination of those materials, which are used to define and stabilize entry channels from the open lake into a harbor.
Pollution	- Any change in water quality that impairs it for the subsequent user. These changes result from contamination of the physical, chemical, or biological properties of water.
Ponar Dredge	- A bottom sediment sampling device which operates similar to a clam-shell dredge. Usually used to sample soft muck, sand and fine gravel sediments and associated benthos.
ppm	- Parts per million.
ppb	- Parts per billion.
Relief	- Elevations or inequalities of a land surface.
Riprap	- A layer, facing, or protective mound of stones randomly placed to prevent erosion, scour, or sloughing of a structure or embankment; also the stone so used.
Sediments	- Clay, sand, gravel or stones which have been eroded from the land or from beneath the water, have been transported by river or lake currents, and re-deposited.

Sheet Steel Piling	- Interlocking lengths of steel ... into a stream, lake or harbor ... next to the shore to prevent storm, wave or ship damage.
Shoal	- A place where water is shallow, sometimes in the shipping channels, created by deposition of eroded material.
Silt	- Finely divided particles of ... rock. Often carried in cloudy suspension in water and eventually deposited as sediment.
Species	- The smallest unit of classification normally used, based on overall resemblances. The species is always written along with the genus, to designate the specific scientific name of an organism.
Substrate	- Any substance used as an attachment point by a microorganism.
Surface Water	- Atmospheric water that runs off to collect in streams, ponds, or lakes, swamps, etc.
Total Kjeldalh Nitrogen (TKN)	- A measure of the ammonia and organic nitrogen, but does not include nitrite and nitrate.
Topography	- The configuration of a surface including its relief, the position of its natural and man-made features.
Turbidity	- A cloudy condition in water due to the suspension of silt or finely divided organic matter.

Volatile Solids (Total)	- A measure of the organic material that could decompose and thus exert an oxygen demand on a body of water.
Water Quality Criteria	- The level of pollutants, with respect to the chemical, physical, and biological characteristics, that affect the suitability of water for a given use.
Wetland	- Lowlands covered by shallow and sometimes temporary or intermittent waters. Important because they store floodwaters, provide food and shelter for wildlife, and improve the quality of water entering lakes and streams.
Zinc	- Zinc (Zn) is a heavy metal which in trace quantities is essential to life, but which in greater quantities may be toxic to life.
Zooplankton	- Planktonic animals that supply food for fish.

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